APPENDIX A

APPENDIX A

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range*	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1984	Leadville	Turquoise Lake No 2	2B 100210 T9S, R80W	30	57	0 2	Lodgepole pine clearcut
1984	Leadville	North Turquoise	2B 100210 T8S, R80W	30	86	0 3	Lodgepole pine clearcut
1984	Leadville	Wurtz	7D 100203 T8S, R80W	50	143	0 5	Lodgepole pine clearcut; spruce/fir shelterwood
1984	Leadville	Ranger Sales	District-wide	80	229	0 8	All species appropriate for Management Area**
1984	Salida	Ptarmigan	4B 101001; 101002 T14S, R80W	320	457	1 6	Spruce/fir group selection
1984	Salida	Beaver Creek No 1	4D 102311 T48N, R7E	200	114	0.4	Douglas-fir thinning; lodgepole pine and aspen. clearcut
1984	Salida	Willow Creek	5B 102211 T49N, R7E	15	29	0 1	Lodgepole pine clearcut
1984	Salida	Spruce Creek No 2	5B 102206 T49N, R7E	30	86	0.3	Aspen: clearcut public fuelwood
1984	Salida	Chubb Park No. 2	4D 101301 T13S, R77W	25	86	0.3	Aspen clearcut public fuelwood
1984	Salida	Ranger Sales	District-wide	320	200	0.7	All species appropriate for Management Area
1984	San Carlos	Snowslide	7A 103510 T24S, R69W	518	1000	3.5	Spruce/fir clearcut; Douglas-fir: two-step shelterwood
1984	San Carlos	Ranger Sales	District-wide	420	257	0.9	All species appropriate for Management Area
1984	Pikes Peak	Ice Cave Creek	10E 115302, 115303 T11S, R68W	314	143	0.5	Ponderosa pine and Douglas-fir. Two-step shelterwood; spruce/ fir and aspen clearcut
1984	Pikes Peak	Davis Gulch	7A 117101, 117102, 117401, 117402 T11 & 12S, R70W	476	286	1 0	Douglas-fir and ponderosa pine two-step shelterwood, aspen clearcut

*All Township and Range notations refer to the New Mexico and Sixth Principal Meridians, United States survey

**See Chapter III, Management Area Prescriptions for harvest methods by species

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1984	Pikes Peak	Johns Gulch	10B 116701, 116002 T11S, R69W	450	286	1.0	Ponderosa pine two-step shelterwood
1984	Pikes Peak	Quaker Ridge	2B 116601, 116701 T11S, R69W	250	143	0.5	Ponderosa pine two-step shelterwood
1984	Pikes Peak	Ranger Sales	District-wide	200	57	0.2	All species. appropriate for Management Area
1984	South Park	Hourglass	7A 108502, 108503 T9S, R73W	450	1686	5 9	Lodgepole pine clearcut, spruce/fir clearcut and shelterwood
1984	South Park	Ranger Sales	District-wide	430	314	1.1	All species appropriate for management area.
1984	South Platte	Green Mountain	2B 122102, 123501 T8S, R71W	529	257	0.9	Douglas-fir two-step shelterwood, ponderosa pine two-step shelterwood and commercial thinning
1984	South Platte	Wigwam Creek	2B 123601; 123607, T9S, R71W	394	286	1.0	Ponderosa pine two-step shelterwood
1984	South Platte	Cabin Creek	2B 123701, 123704 T9S, R71W	471	229	0.8	Douglas-fir and ponderosa pine: two-step shelterwood
1984	South Platte	Sixmile Creek	2B 123904 T9S, R71W	176	86	0 3	Douglas-fir and ponderosa pine two-step shelterwood
1984	South Platte	Ranger Sales	District-wide	1550	1000	3.5	All species appropriate for management area.
1985	Leadville	Mt. Zion No 1	5B 100202 T9S, R80W	110	314	1.1	Lodgepole pine: clearcut, spruce/fir: selection
1985	Leadville	Ranger Sales	District-wide	120	229	0 8	All species: appropriate for Management Area
1985	Salida	Jones Mountain	9B 101001 T14S, R81W	450	571	2.0	Spruce/fir group selection
1985	Salida	Dry Lakes No 2	5B 101901 T50N, R7E	10	29	0.1	Lodgepole pine: clearcut

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1985	Salida	Chalk Creek	2B 101611; 101610 T15S, R79W	20	57	0 2	Aspen clearcut
1985	Salida	South Cottonwood	2B 101106 T14S, R79W	20	57	0 2	Aspen clearcut
1985	Salida	Spruce Creek No 3	5B 102206, 102205 T49N, R7E	40	114	0.4	Aspen: clearcut public fuelwood
1985	Salida	Chubb Park No. 3	4D 101301 T13S, R77W	30	86	0 3	Aspen clearcut public fuelwood
1985	Salida	Ranger Sales	District-wide	250	143	0 5	All species. appropriate for Management Area
1985	San Carlos	Adobe Peak	7A 103310 T21S, R70W	996	771	2.7	Douglas-fir and ponderosa pine: two-step shelterwood and clearcut
1985	San Carlos	Indian Creek	7A 103901 T30S, R69W	950	771	2 1	Douglas-fir and ponderosa pine: two-step shelterwood
1985	San Carlos	Ranger Sales	District-wide	400	286	1.0	All species: appropriate for Management Area
1985	Pikes Peak	Plum Creek	7D 114903, 114904, 114905, 115101, 115102, 115201, 115202 T10S, R68W	250	286	1 0	Lodgepole pine. clearcut, Douglas-fir and ponderosa pine· two-step shelterwood spruce shelterwood
1985	Pikes Peak	Old Phantom	2B 117204 T11S, R70W	220	86	0 3	Ponderosa pine and Douglas-fir· two-step shelterwood
1985	Pikes Peak	Old Station	7A 117001, 117101, 117102 T11 & 12S, R69 & 70W	250	86	0.3	Douglas-fir and ponderosa pine. two-step shelterwood
1985	Pikes Peak	7-Wire	2B 116601, 116602; 116603, 116604, 116803, 115501, 117503 T11S, R69W	231	86	0 3	Ponderosa pine two-step shelterwood and commercial thinning
1985	Pikes Peak	Saylor Park	2A, 7D 114901, 114902; 114903, 115202 T11S, R68W	200	171	0 6	Aspen and spruce/fir· clearcut, ponderosa pine and Douglas-fir two-step shelterwood
1985	Pikes Peak	Long Gulch No 1	7D 117303, 117404 T12S, R70W	350	143	0.5	Ponderosa pine and Douglas-fir two-step shelterwood
1985	Pikes Peak	Ranger Sales	District-wide	80	57	0 2	All species appropriate for Management Area

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1985	South Park	North Fork	7A 108203, 108205; 108206, 108501; 108601, 108602; T7, 8 & 9S, R73W	599	1286	4.5	Lodgepole pine: clearcut; spruce/ fir· clearcut & two-step shelterwood & commercial thinning
1985	South Park	Ranger Sales	District-wide	800	714	1.5	Lodgepole pine: clearcut & commercial thin, aspen clearcut; ponderosa pine. commercial thin & pre-commercial thin
1985	South Platte	Sugar Creek	7A 124302; 124303 T9S, R69 & 70W	2706	1314	4.6	Douglas-fir and ponderosa pine two-step shelterwood
1985	South Platte	Ranger Sales	District-wide	825	543	1.0	All species· appropriate for Management Area
1986	Leadville	Mt. Zion No 2	4D 100202 T9S, R80W	120	343	1.2	Spruce/fir: shelterwood, lodgepole pine: clearcut
1986	Leadville	Ranger Sales	District-wide	120	200	0 7	All species. appropriate for Management Area
1986	Salida	Kruetzer	9B 101102 T15S, R80W	220	229	0.8	Spruce/fir: single tree selection
1986	Salida	Sands	7D 101705 T51N, R7E	160	114	0.4	Ponderosa pine and Douglas-fir: two-step shelterwood
1986	Salida	Spruce Creek No 4	9B 102205, 102206 T49N, R7E	40	114	0.4	Aspen. clearcut, public fuelwood
1986	Salida	Chubb Park No 4	4D 101301 T13S, R77W	30	86	0.3	Aspen clearcut public fuelwood
1986	Salida	Eddy Creek	7D 101707 T15S, R79W	380	286	1.0	Ponderosa pine· two-step shelterwood
1986	Salida	Ranger Sales	District-wide	420	229	0.8	All species: appropriate for Management Area
1986	San Carlos	Little Froze	7A 103503 T23S, R70W	1387	1200	3.2	Spruce/fir and aspen clearcut and two-step shelterwood
1986	San Carlos	East Williams	4D, 7A 103508, 103705 T23 & 24S, R69 & 70W	965	771	2.7	Spruce/fir and aspen clearcut and two-step shelterwood
1986	San Carlos	Ranger Sales	District-wide	470	171	.6	All species· appropriate for Management Area

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range*	Treatment Area (Acres)[1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1986	Pikes Peak	Frosty	2A 120501 T15S, R68W	280	400	1 4	Spruce/fir· shelterwood and commercial thinning, aspen clearcut
1986	Pikes Peak	Ryan	2B 115801, 115802 T11S, R69W	143	86	0.3	Douglas-fir two-step shelterwood, ponderosa pine: two-step shelterwood and commercial thinning
1986	Pikes Peak	Ski Sale	10E 119102, 119104 T13S, R69W	25	29	0 1	Spruce/fir shelterwood and clearcut
1986	Pikes Peak	Long Gulch No. 2	7D 117303; 117404 T12S, R70W	353	171	0.6	Ponderosa pine and Douglas-fir: two-step shelterwood and commercial thinning
1986	Pikes Peak	Ranger Sales	District-wide	170	57	0.2	All species: appropriate for Management Area
1986	South Park	Guernsey	6B 100102 T7S, R75 & 76W	200	286	1.0	Aspen & lodgepole pine clearcut, spruce/fir· clearcut & two-step shelterwood
1986	South Park	Crooked Creek	4B, 5B 100801; 100802, 100803 100901, 100902; 100903 T8 & 9S, R76 & 77W	700	1000	3.5	Aspen and lodgepole pine: clearcut; spruce fir: clearcut, two-step shelterwood, and selection
1986	South Park	Ranger Sales	District-wide	800	714	1 5	Lodgepole pine. clearcut ponderosa pine commercial thinning and two-step shelterwood
1986	South Platte	Crow Gulch	5B; 2B 105401, 105301, 105302 T6S & 7S, R73W	166	286	1 0	Lodgepole pine and aspen clearcut; Douglas-fir and ponderosa pine: two-step shelterwood
1986	South Platte	Sheep Rock	3A, 7D 126001, 126002; 125801, 125802, 128801 T10S, R71W	692	257	0.9	Ponderosa pine. two-step shelterwood and commercial thinning
1986	South Platte	Dakan Mountain	2B, 5B, 7D 127301; 127302, 127303 T9 & 10S, R68W T9S, R69W	300	286	1 5	Lodgepole pine and aspen. clearcut; ponderosa pine two-step shelterwood
1986	South Platte	Brush Creek	7A 124001; 124002, 124101; 124102 T8 & 9S, R70W	706	429	1 0	Ponderosa pine and Douglas-fir two-step shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range*	Treatment Area (Acres)[1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1986	South Platte	Ranger Sales	District-wide	950	600	1 1	All species appropriate for Management Area
1987	Leadville	East Tennessee	4B 100203 T8S, R80W	100	286	1 0	Lodgepole pine clearcut, spruce/ fir· shelterwood
1987	Leadville	Ranger Sales	District-wide	120	229	0 8	All species appropriate for Management Area
1987	Salida	Starvation Creek	9B 102308, 102310 T49N, R6E	280	286	1 0	Spruce/fir clearcut and commercial thinning
1987	Salida	Herring	4D 101405 T15S, R76W	250	171	0.6	Douglas-fir· two-step shelterwood, aspen clearcut
1987	Salida	Chubb Park No 5	4D 101301 T13S, R77W	40	114	0 4	Aspen clearcut public fuelwood
1987	Salida	Beaver Creek No 1	4D 102311 T48N, R7E	40	114	0 4	Aspen clearcut public fuelwood
1987	Salida	Ranger Sales	District-wide	525	286	1 0	All species· appropriate for Management Area
1987	San Carlos	Gost	7A 102701; 102702 T46 & 47N, R12E	1272	971	2.4	Douglas-fir and ponderosa pine two-step shelterwood
1987	San Carlos	Amethyst	7A, 9B 103510 T24S, R69W	1200	943	3.3	Spruce/fir: clearcut and group selection
1987	San Carlos	Ranger Sales	District-wide	550	229	8	All species· appropriate for Management Area
1987	Pikes Peak	Stone Gulch	7D 117303, 117404 T12S, R70W	600	286	1 0	Douglas-fir and ponderosa pine: commercial thinning & two-step shelterwood; aspen· clearcut
1987	Pikes Peak	Stark	2B 114302, 114303 T10S, R68W	450	343	1 2	Lodgepole pine clearcut, Douglas-fir two-step shelterwood and commercial thinning
1987	Pikes Peak	Long Gulch No 3	7D 117303, 117404 T12S, R70W	294	143	0 5	Ponderosa pine and Douglas-fir two-step shelterwood and commercial thinning

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1987	Pikes Peak	Ranger Sales	District-wide	175	86	0 3	All species appropriate for Management Area
1987	South Park	Michigan Creek	9B, 2B 100301, 100302, 100402, 100601, 100602, 100603, 100604 T7 & 8S, R76W	700	1286	4 5	Aspen clearcut, lodgepole pine clearcut and commercial thinning, spruce/fir clearcut, two-step shelterwood, group selection and commercial thinning
1987	South Park	Ranger Sales	District-wide	650	714	1 5	All species appropriate for management area
1987	South Platte	Callahan Gulch	2B, 5B 105902, 106001 T6 & 7S, R74 & 75W	1500	1429	4 0	Aspen, lodgepole pine clearcut, Douglas-fir and ponderosa pine two-step shelterwood, spruce/fir selection
1987	South Platte	Dake Lake	5B 106601, 106602 T7S, R75W	275	314	1 1	Aspen, lodgepole pine and spruce/fir: clear-cut; ponderosa pine two-step shelterwood
1987	South Platte	Ranger Sales	District-wide	300	114	0 4	All species appropriate for Management Area
1988	Leadville	Missouri Hill	2B 100203 T8S, R80W	175	285	1 0	Lodgepole pine clearcut and commercial thinning
1988	Leadville	Ranger Sales	District-wide	220	228	0 8	All species appropriate for Management Area
1988	Salida	Cow Gulch	4D 101405, T15S, R76W	20	57	0 2	Aspen. clearcut public fuelwood
1988	Salida	Beaver Creek No 2	4D 102311 T48N, R7E	40	114	0 4	Aspen. clearcut public fuelwood
1988	Salida	Silver Prince	5B 101612 T14N, R79E	20	57	0.2	Aspen: clearcut public fuelwood
1988	Salida	Eddy Creek	7D 101707 T15S, R79W	360	257	0 9	Ponderosa pine and Douglas-fir. two-step shelterwood
1988	Salida	Ranger Sales	District-wide	600	343	1 2	All species appropriate for Management Area
1988	San Carlos	Wolf Lake	2B 104003 T31 & 32S, R69W	1754	1200	3 2	Spruce/fir clearcut and shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1988	San Carlos	South Middle	7A 103901 T30S, R69 & 70W	650	486	1.7	Spruce/fir and Douglas-fir clear-cut and three-step shelterwood
1988	San Carlos	Ranger Sales	District-wide	660	457	1.6	All species appropriate for Management Area
1988	Pikes Peak	Mt. Rosa	4D 120502, 120501 T15S, R68W	200	286	1 0	Spruce/fir and aspen clearcut
1988	Pikes Peak	Catamount	10E 119101; 119102 T13S, R69W	250	286	1 0	Aspen clearcut, Douglas-fir and ponderosa pine· two-step shelterwood; spruce/fir commercial thinning & shelterwood
1988	Pikes Peak	Microwave	2B 114404 T10S, R68W	200	143	0 5	Aspen clearcut, lodgepole pine· clearcut and commercial thinning
1988	Pikes Peak	Ranger Sales	District-wide	250	86	0 3	All species: appropriate for Management Area
1988	South Park	Dicks Peak	5B 113801, 113802 T14S, R74W	400	514	1 8	Aspen: clearcut, Douglas-fir· clearcut and two-step shelter-wood; spruce/fir: selection
1988	South Park	Jones Hill	7D, 6B 102801, 102802, 102803; 102804, 102602; 102702	800	857	3 0	Aspen: clearcut, lodgepole pine· clearcut & commercial thinning; spruce/fir: clearcut & two-step shelterwood, Douglas-fir and ponderosa pine two-step shelterwood
1988	South Park	Ranger Sales	District-wide	700	629	1 2	All species: appropriate for management area
1988	South Platte	Thunder Butte	2B, 3A 126701, 126702, 126602 T10S, R70W	800	571	1.0	Douglas-fir and ponderosa pine. two-step shelterwood and commercial thinning
1988	South Platte	Noddles	2B 123001, 123002, 123003; 123101; 123102, 123103 T8S, R69W	588	286	1 0	Douglas-fir and ponderosa pine· two-step shelterwood
1988	South Platte	Sheep Nose	7A 127802, 127901, 129201 T10S, R70W	235	114	0 4	Douglas-fir and ponderosa pine two-step shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1988	South Platte	Long Scraggy	7A 123202, 123203 T8S, R70W	176	86	0 3	Douglas-fir and ponderosa pine two-step shelterwood
1988	South Platte	North Elk Creek	5B 103801 T6S, R72W	550	571	2 0	Lodgepole pine, aspen: clearcut, spruce/fir selection
1988	South Platte	Bruno Gulch	2A, 1B 104801, 104901, 104902 T6S, R75W	552	1057	3.7	Lodgepole pine and spruce/fir· clearcut & commercial thinning
1988	South Platte	Ranger Sales	District-wide	200	143	0.5	All species· appropriate for Management Area
1989	Leadville	Wurtz No. 2	7D 100203 T10S, R80W	100	286	1.0	Lodgepole pine clear-cut; spruce/fir shelter-wood
1989	Leadville	Ranger Sales	District-wide	80	229	0.8	All species appropriate for Management Area
1989	Salida	The Gate	9B 102307 T47N, R7E	300	286	1.0	Spruce/fir and lodgepole pine· clearcut and commercial thinning
1989	Salida	Silver Creek No 2	2B 102304 T48N, R8E	200	114	0 4	Douglas-fir. two-step shelterwood, lodgepole pine clearcut and commercial thinning
1989	Salida	Kismuth	2B, 9B 102308, 102309 T48N, R7E	75	86	0.3	Douglas-fir and ponderosa pine two-step shelterwood, lodgepole pine clearcut and com-mercial thinning
1989	Salida	Silver Prince	5B 101612 T14S, R79W	20	57	0 2	Aspen clearcut public fuelwood
1989	Salida	Cow Gulch	4D 101405 T15S, R76W	20	57	0 2	Aspen: clearcut public fuelwood
1989	Salida	Beaver Creek No. 3	4D 102311 T48N, R7E	40	114	0 4	Aspen· clearcut public fuelwood
1989	Salida	Ranger Sales	District-wide	450	314	1.1	All species appropriate for Management Area
1989	San Carlos	Little Saint	7A 103510 T24S, R69W	313	1143	4 0	Spruce/fir two-step shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1989	San Carlos	Pole Creek	7A, 6B 103702 T24S, R69 & 70W	791	743	1 6	Spruce/fir and aspen clearcut and shelterwood
1989	San Carlos	Ranger Sales	District-wide	425	257	9	All species appropriate for Management Area
1989	Pikes Peak	Raspberry	2B 119001 T13S, R69W	200	371	1 0	Spruce/fir shelterwood, aspen. clearcut, Douglas-fir and ponderosa pine two-step shelterwood and commercial thinning
1989	Pikes Peak	Elk Park	2A 120704 T15S, R68W	200	171	0 6	Spruce/fir shelterwood and commercial thinning
1989	Pikes Peak	Wildhorn	2 B 117201, 117202, 117203 T11 & 12S, R70W	300	143	0 5	Aspen and lodgepole pine clearcut, Douglas-fir two-step shelterwood, ponderosa pine commercial thinning
1989	Pikes Peak	Ranger Sales	District-wide	250	143	0 5	All species appropriate for Management Area
1989	South Park	39-Mile Mountain	7A 113601, 113602, 113501 T14S, R73W	800	1286	4 5	Aspen clearcut, spruce/fir clearcut, two and three-step shelterwood and commercial thinning, Douglas-fir. two-step shelterwood and clearcut
1989	South Park	Ranger Sales	District-wide	700	714	1 5	All species appropriate for management area
1989	South Platte	Buffalo Creek	2B 122001, 122002, 122003 T8S, R71W	500	286	1 0	Douglas-fir and ponderosa pine two-step shelterwood and commercial thinning
1989	South Platte	Hall Valley	5B, 2B 106601, 106503, 106504, 105901 T7S, R75W	1000	857	2 0	Lodgepole pine, aspen. clearcut, spruce/fir selection
1989	South Platte	Shingle Mill Creek	2B 121601, 121602, 121603 T8S, R70 & 71W	900	543	1 9	Ponderosa pine and Douglas-fir two-step shelterwood and commercial thinning
1989	South Platte	Ranger Sales	District-wide	250	171	0 6	All species appropriate for Management Area

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1990	Leadville	West Tennessee No 2	2B 100205 T8S, R80W	100	286	1 0	Lodgepole pine· clearcut, spruce/fir clearcut
1990	Leadville	Ranger Sales	District-wide	100	229	0 8	All species appropriate for Management Area
1990	Salida	Ouray Creek	2B 102301, 102310 T48N, R7E	300	314	1 1	Spruce/fir shelterwood, lodgepole pine: clearcut and commercial thinning
1990	Salida	Squaw Creek No 3	7D 101801, 101806 T50N, R7E	400	114	0 4	Ponderosa pine· two-step shelterwood & commercial thinning
1990	Salida	Little Cochetopa No 2	9B 102206 T49N, R7E	60	114	0 4	Lodgepole pine clearcut and commercial thinning
1990	Salida	North Fork	5B 101806 T50N, R7E	15	29	0 1	Lodgepole pine· clearcut and commercial thinning
1990	Salida	Bull Gulch No 1	4D 101406 T15S, R77W	40	114	0 4	Aspen clearcut public fuelwood
1990	Salida	Poncha Loop No 1	5B 102312 T48N, R7E	50	143	0 5	Aspen clearcut public fuelwood
1990	Salida	Ranger Sales	District-wide	450	229	0 8	All species appropriate for Management Area
1990	San Carlos	Millset	4B 103512, 103513 T24S, R68W	931	1571	4 5	Spruce/fir clearcut and two-step shelter-wood
1990	San Carlos	Rainbow	7A 102703 T46 & 47N, R11 & 12E	400	257	0 9	Douglas-fir and ponderosa pine two-step shelter-wood
1990	San Carlos	Ranger Sales	District-wide	460	314	1 1	All species appropriate for Management Area
1990	Pikes Peak	Trail	7A 117001, 117101, 117102 T11 & 12S, R69 & 70W	650	257	0 9	Douglas-fir and ponderosa pine two-step shelterwood
1990	Pikes Peak	Crystal	10E 119201, 119202, 119103, 119104 T13S, R68 & 69W	60	86	0 3	Aspen clearcut, Douglas-fir two-step shelterwood, spruce/fir clear-cut and commercial thinning

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1990	Pikes Peak	Skagway	2A 120601, 120701 T15S, R68W	250	143	0.5	Aspen: clearcut, Douglas-fir two-step shelterwood
1990	Pikes Peak	Missouri Gulch	7D 114901 T11S, R68W	175	200	0 7	Aspen and lodgepole pine clearcut, Douglas-fir two-step shelterwood
1990	Pikes Peak	Ranger Sales	District-wide	150	57	0 2	All species appropriate for Management Area
1990	South Park	Lynch Peak	6B 102603, 102502, 102503, 102504, 102505, 102506, 102902 T11 & 12S, R78W	800	1286	3 5	Aspen: clearcut, lodgepole pine clear-cut, spruce/fir clear-cut, two & three-step shelterwood, commercial thinning, Douglas/fir two-step shelterwood
1990	South Park	Ranger Sales	District-wide	700	714	2 5	All species appropriate for management area
1990	South Platte	Meridian Hill	7D 104001, 103901, 104101 T6S, R72 & 73W	880	1257	3 4	Aspen· clearcut, lodgepole pine and spruce/fir clearcut commercial thinning, ponderosa pine two-step shelterwood
1990	South Platte	Green Mtn Creek	2B, 7A 123705, 123801, 123904, 123401, 123402 T8 & 9S, R71W	721	857	2 0	Aspen: clearcut, ponderosa pine and Douglas-fir two-step shelterwood and commercial thinning
1990	South Platte	Bruno Gulch	2A, 1B 104801, 104901, 104902 T6S, R75W	500	857	2 0	Lodgepole and spruce/fir shelterwood and commercial thinning
1990	South Platte	Ranger Sales	District-wide	450	143	0 5	All species appropriate for Management Area
1991	Leadville	West Tennessee No 3	2B 100205 T8S, R81W	100	286	1 0	Lodgepole pine. clear-cut, spruce/fir· shelter-wood
1991	Leadville	Ranger Sales	District-wide	120	229	0 8	All species appropriate for Management Area
1991	Salida	Chubb Park	4D 101301 T13S, R78W	380	543	1 9	Spruce clearcut and shelterwood
1991	Salida	Poncha Loop No 2	5B 102312 T48N, R78W	50	143	0 5	Aspen clearcut public fuelwood
1991	Salida	Bull Gulch No 2	4D 101406 T15S, R76W	40	114	0 4	Aspen clearcut public fuelwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1991	Salida	Ranger Sales	District-wide	470	286	1.0	All species appropriate for Management Area
1991	San Carlos	Asher	7A, 2B 103407 T22S, R69W	750	514	1.8	Douglas-fir & ponderosa pine. two-step, shelterwood
1991	San Carlos	Mammoth	9B 103505	408	1257	3 4	Spruce/fir clearcut and commercial thinning
1991	San Carlos	Ranger Sales	District-wide	525	371	1 3	All species: appropriate for Management Area
1991	Pikes Peak	Asay	2B 114901; 114902, 114903, 115202 T11S, R68W	40	57	0 2	Aspen clearcut
1991	Pikes Peak	Baldy	2A 120704 T15S, R68W	120	114	0 4	Aspen clearcut; Spruce/fir shelterwood and commercial thinning
1991	Pikes Peak	Mineral Mtn	2B 114901, 114902, 114903, 115202 T11S, R68W	254	143	0 5	Aspen· clearcut, spruce/fir: shelterwood, ponderosa pine and Douglas-fir. two-step shelterwood
1991	Pikes Peak	Douglas	2B 114901, 114902, 114904, 114903, 115202 T10S, R68W	446	371	1.3	Aspen. clearcut, ponderosa pine and Douglas-fir· two-step shelterwood, lodgepole pine. commercial thinning, spruce/fir: shelterwood
1991	South Park	Caylor	2B, 4B 112103, 112104, 112302, 112303, 112304; 112305 T12 & 13S, R72 & 73W	400	286	1.0	Ponderosa pine clearcut, two-step shelterwood, commercial thinning, Douglas-fir two-step shelterwood, clearcut, commercial thinning
1991	South Park	Selkirk	2B, 6B 100501, 100503, 100703; 100704 T8S, R77 & 78W	700	857	3.0	Aspen: clearcut, lodgepole pine. clearcut; spruce/fir: clearcut, two-step shelterwood and group selection
1991	South Park	Ranger Sales	District-wide	800	857	2.0	Aspen. clearcut, lodgepole pine. clearcut, spruce/fir and ponderosa pine· two-step shelterwood
1991	South Platte	Elk Creek	7D 104201, 104202, 104102 T6S, R73W	360	514	1 8	Aspen & spruce/fir clearcut, lodgepole pine clearcut & commercial thinning, ponderosa pine· two-step shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1991	South Platte	Deer Creek	2B 104301; 104201, 104202; 104401, 104402 T6 & 7S, R73W	700	100	2 5	Aspen clearcut, spruce/fir shelterwood; lodgepole pine clearcut and commercial thinning, ponderosa pine two-step shelterwood
1991	South Platte	Ranger Sales	District-wide	600	343	1 2	All species appropriate for Management Area
1992	Leadville	Long's Gulch	2B 100208 T8S, R80W	100	286	1 0	Lodgepole pine clearcut, spruce/fir shelterwood
1992	Leadville	Ranger Sales	District-wide	120	229	0 8	All species appropriate for Management Area
1992	Salida	Methodist Mtn	5B 102403, 102314 T49N, R9E	80	143	0 5	Lodgepole pine clearcut
1992	Salida	Antelope Gulch	4D, 6B 101407, 102102 T51N, R10E	250	143	0 5	Douglas-fir and ponderosa pine two-step shelterwood
1992	Salida	Weldon No. 1	7A 101806 T40N, R7E	50	143	0 5	Aspen clearcut public fuelwood
1992	Salida	Calf Gulch No. 1	4D 101406 T15S, R76W	40	114	0.4	Aspen: clearcut public fuelwood
1992	Salida	Ranger Sales	District-wide	800	343	1 2	All species appropriate for Management Area
1992	San Carlos	Stuhl	7A 103309, 103310, 103311 T20 & 21S, R70W	1920	886	3 1	Douglas-fir & ponderosa pine. two-step shelterwood and commercial thinning
1992	San Carlos	Cottonwood	7A 102901, 103002 T25S, R72W	1900	800	2 0	Douglas-fir & ponderosa pine two-step shelterwood and commercial thinning
1992	San Carlos	Ranger Sales	District-wide	600	457	1 0	All species appropriate for Management Area
1992	Pikes Peak	Say	2B 114901, 114902; 114903, 115202 T11S, R68W	100	171	0 6	Lodgepole pine clearcut
1992	Pikes Peak	Glen	9B 119101, 119002, 119003 T13S, R69W	400	257	0 9	Spruce/fir clearcut and commercial thinning, aspen clearcut, Douglas-fir two-step shelterwood

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres) [1]	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1992	Pikes Peak	Park	2B 114901; 114902, 114903, 115202 T11S, R68W	189	143	0 5	Lodgepole pine· clearcut and commercial thinning
1992	Pikes Peak	South Fork	7A 117101, 117102, 117401, 117402 T11 & 12S, R70W	350	143	0 5	Douglas-fir two-step shelterwood, ponderosa pine two-step shelterwood and commercial thinning
1992	South Park	Twelve Mile	4B, 5B, 9B 101902, 101903; 101904, 102003, 102004, 102104, 102105 T10S, R78W	1500	1143	4 0	Aspen clearcut; lodgepole pine clearcut spruce/fir· clearcut and two-step shelterwood
1992	South Park	Ranger Sales	District-wide	1200	857	2.0	All species: appropriate for management area
1992	South Platte	Meridian Hill	7D 104001, 103901, 104101 T6S, R72 & 73W	1800	1257	4 4	Aspen clearcut lodgepole pine and spruce/fir shelterwood and commercial thinning, ponderosa pine two-step shelterwood
1992	South Platte	Ranger Sales	District-wide	600	600	1 1	All species. appropriate for Management Area
1993	Leadville	Porcupine	2B 100208 T8S, R80W	100	286	1 0	Lodgepole pine· clearcut; spruce/ fir· two-step shelterwood
1993	Leadville	Ranger Sales	District-wide	120	229	0 8	All species appropriate for Management Area
1993	Salida	Kauffman Ridge	6B 101402, 101305, 101303 T14S, R76W	675	429	1.5	Douglas-fir and ponderosa pine. two-step shelter-wood
1993	Salida	Weldon No 2	7A 101806 T50N, R7E	40	114	0 4	Aspen clearcut public fuelwood
1993	Salida	Calf Gulch No 2	4D 101406 T15S, R76W	50	143	0 5	Aspen: clearcut public fuelwood
1993	Salida	Ranger Sales	District-wide	700	343	1.2	All species· appropriate for Management Area
1993	San Carlos	Breece Creek	6B 103502 T23S, R70W	1240	886	2 1	Douglas-fir and ponderosa pine two-step shelterwood and commercial thinning

TIMBER SALE SUMMARY

Fiscal Year	District	Sale Name	Area Location -Management Area -RIS Location -Township & Range	Treatment Area (Acres)	Estimated Volume MCF	Estimated Volume MMBF	Probable Harvest Methods by Forest Type
1993	San Carlos	Green Mtn	4B 103101 T27 & 28S, R71 & 72W	1760	857	3 0	Spruce/fir and aspen clearcut and two-step shelterwood
1993	San Carlos	Ranger Sales	District-wide	560	400	1 4	All species appropriate for Management Area
1993	Pikes Peak	Gould	2A 120602; 120504 T15S, R68W	587	343	1 2	Douglas-fir and ponderosa pine two-step shelterwood, aspen clearcut
1993	Pikes Peak	Tunnel	2B 118501, 118503, 118301, 118302 T12 & 13S, R68W	525	286	1 0	Douglas-fir and other species two-step shelterwood
1993	Pikes Peak	Hurricane	9B 119201, 119202, 119203, 119402, 119403, 119404 T13 & 14S, R68W	400	171	0 6	Aspen clearcut, spruce/fir and ponderosa pine two-step shelterwood and commercial thinning
1993	South Park	39 Mile Mtn II	7A, 6B 113501, 113502, 113401, 113402 T14S, R73W	1000	1286	4 5	Aspen clearcut, spruce/fir clearcut, commercial thinning, and two and three-step shelterwood, Douglas-fir clearcut and two and three-step shelterwood, ponderosa pine two-step shelterwood
1993	South Park	Ranger Sales	District-wide	800	714	1.5	All species appropriate for management area
1993	South Platte	Black Mountain	7D 103701 T6S, R72W	1250	1143	3.0	Aspen clearcut, lodgepole pine and spruce/fir shelterwood & commercial thinning
1993	South Platte	Ranger Sales	District-wide	625	714	2.5	All species appropriate for Management Area

Sales in this summary pertain to harvests from suitable forest lands only, and are included in the Allowable Sale Quantity (ASQ) In addition to volumes shown above, an unspecified amount of wood from trees less than 7 inches in diameter, topwood less than 6 inches in diameter, and trees from catastrophic events such as wildfire and windthrows will be harvested, but are not part of the ASQ A small amount of wood will be harvested from unsuitable lands that are also not included in the ASQ. This amount is estimated to be approximately 30 percent of the figures shown above

APPENDIX B

APPENDIX B

DETERMINATION OF LANDS SUITABLE FOR TIMBER PRODUCTION

The identification of suitable lands was completed using criteria provided in 36 CFR 219.14.

Suitable lands needed for timber production under the proposed alternative total 581,550 acres. The following table compares the land-use components of the previous plan with equivalent areas of suitable land in the proposed action alternative.

The Forests' previous timber management plans were approved in 1962 and based upon forest inventory data collected in 1958. Much of the information provided by our recent inventory (completed in 1980) is not comparable to the older data because analysis procedures have changed dramatically over the last 22 years.

Timber size and age class distributions and volume determinations reflect acreage corrections based on field checks of inventory data not previously available.

Maps displaying the location of lands suitable for timber production are available for review and inspection at the Forest Supervisor's Headquarters in Pueblo, Colorado.

TABLE B-1

LANDS AVAILABLE AND SUITABLE FOR TIMBER PRODUCTION

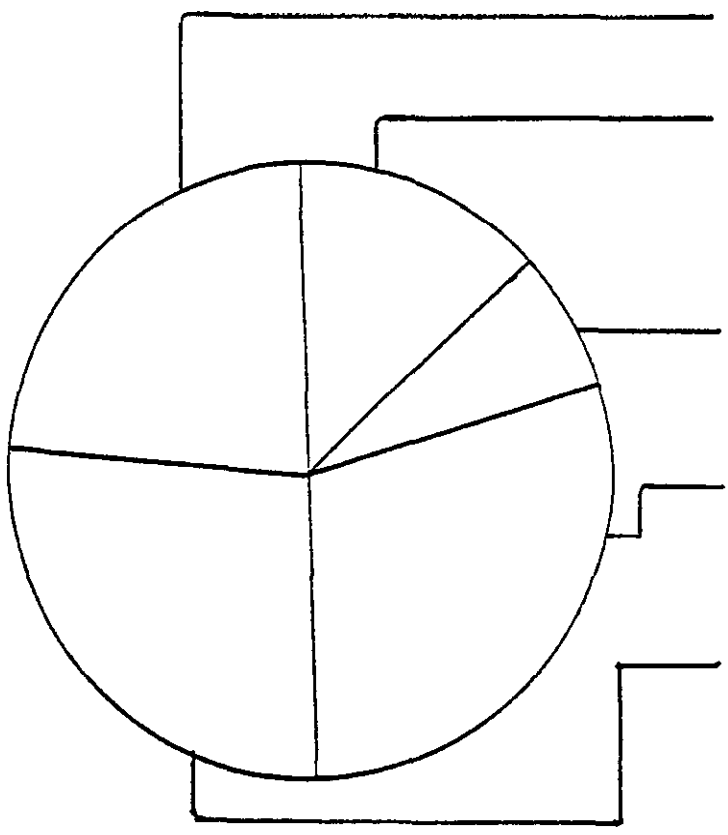
Criterion	Classification	Acres
	Net National Forest Ownership*	2,224,689
	Water	9,845
	Nonforest Land	517,343
	Forest Land	1,697,501
	A. Nonproductive/uneconomical (Less than 20 CF/Ac/Yr)	264,888
Legislatively or Administratively Withdrawn	B. Productive but not Available	
	1. Reserved	
	Wilderness	130,302
	Wild and Scenic Rivers	0
	Natural Areas	790
	Special Areas	0
	2. Deferred	
	Wilderness Study Areas	
	-designated by Congress	102,700
	-designated by Administration	18,600
	C. Productive and Available but not Suitable	
Lack of Technology	1. Technologically Not Suitable	
	Irreversible Soil or Watershed Damage	69,976
	Five Year Regeneration (Rocky)	27,824
Administrative Allocation	2. Administratively Not Suitable	
	Experimental Forest	12,418
	Administrative Sites	4,783
	D. Tentatively Suitable Land	1,065,220

*Pike and San Isabel National Forest Units only. The Comanche and Cimarron National Grasslands are excluded from this summary because they contain no suitable forest land.

FIGURE B-1

LANDS SUITABLE FOR TIMBER PRODUCTION

Total National Forest Area*(Net) 2,224,689



Area Non-Forested (including water)	527,188
Area Not Capable	264,888
Area Not Available	161,942
Area Not Suitable	689,121
Area Capable, Available and Suitable for Timber Production	581,550

* Includes only Pike and San Isabel National Forests. Does not include the Comanche or Cimarron National Grasslands.

DEFINITIONS FOR TERMS ON PAGE B-2

Net National Forest Ownership: The acreage of Federal lands which have been designated by Executive Order or statute as National Forest, National Grasslands, or Purchase Units.

Water: Streams, sloughs, estuaries, and canals 120 feet or more in width; and lakes, reservoirs, and ponds more than one acre in area.

Nonforest Land: Land that has never supported forests and lands formerly forested where use for timber utilization is precluded by development for other use. Includes areas used for crops, improved pasture, residential areas, improved roads of any width and adjoining clearings, and powerline clearing of any width. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearing more than one acre in size to qualify as nonforest land. The nonforest land is classified as land not suited for timber production.

Forest Land: Land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use.

Nonproductive Forest Land: Forest land which is not capable of growing industrial crops of wood at a growth potential of 20 cubic feet per acre annually. Nonproductive forest land is not suited for timber production.

Productive Forest Land: Forest land which is capable of growing industrial crops of wood at or above 20 cubic feet per acre per year. This classification includes both accessible and inaccessible, stocked and nonstocked land.

Unavailable Forest Land-Deferred: Productive forest land which has been withdrawn from timber production by the Secretary or Chief of the Forest Service. Productive but not available forest land is classed as not suited for timber production.

Unavailable Forest Land-Reserved: Productive forest land which has been legislatively withdrawn or administratively withdrawn from timber production on a permanent basis. Examples of this classification are Wilderness Areas, Primitive Areas, Research Natural Areas or special interest areas or similar formal withdrawals approved by the Chief or higher authority.

Productive And Available: Productive forest land which has not been legislatively withdrawn or administratively withdrawn from timber production by the Secretary or the Chief of the Forest Service. This classification includes RARE II Further Planning Areas and administrative designation below the Chief's level withdrawing land from timber production.

Technologically Not Suitable/Irreversible Resource Damage: Forest land that is productive and available for timber production but technology is not available that will ensure timber production, including harvesting, from the land without irreversible resource damage to soil productivity or watershed condition. Availability of technology is judged on whether technology is currently developed and available for use. This is not an economic test, and the technology does not have to be available in the local area.

Technologically Not Suitable/Over Five-Year Regeneration: Forest land that is productive and available for timber production but where there is not reasonable assurance that such lands can be adequately restocked within 5 years after final harvest. The five year regeneration requirement does not apply in areas managed to promote non-timber resource values.

Administratively Not Suitable: Forest land that is productive and available but is not organized for timber production under sustained yield principles because of long-term allocations made prior to this planning effort. Some timber may be cut from these areas but it will generally be a by-product of some other management activity. Experimental Forest and developed recreation sites are normally included in this component.

Productive, Available And Tentatively Suitable Forest Land: Productive forest land that has not been legislatively or administratively withdrawn and is physically suited for timber production.

TABLE B-2

COMPARISON WITH PREVIOUS PLAN (1962)

	1962 PLAN ACRES	THIS PLAN ACRES	PERCENT 1/ CHANGE (%)
AREA SUMMARY			
Net National Forest	2,182,795	2,224,689	+ 2%
Total Forested Land	1,713,358	1,697,501	- 1%
Total Productive Forest Land	1,457,040	1,432,613 2/	- 1%
Total Comm. Forest Land	1,210,818	1,180,221 3/	- 3%
Total Nonproductive	256,318	264,888 4/	+ 3%
Total Nonforest (including water)	469,437	527,188	+11%

1/ Percent change from Previous Plan
2/ Productive forest land
3/ Available productive forest land (Does not include Productive Reserved or Deferred as displayed below)
4/ Nonproductive forest land (uneconomical)

PRODUCTIVE FOREST LAND NOT AVAILABLE	Acres	Acres	% Change
Productive Reserved	6,890	131,092	+1,803%
Productive Deferred	239,332	121,300	- 49%

PREVIOUS PLAN Commercial Forest Land	Acres	THIS PLAN Tentatively Suitable Forest Land* By Use Category	Acres
Standard	234,917	Operable Slopes (0-40%)	769,948
Special	388,674 5/	Steep Slopes (40-70%)	241,272
		Riparian	0
		Esthetic Retention	54,000 7/
		Wildlife Retention	0
		Bear Habitat	0
Marginal	441,060 6/		
Unregulated	146,167		
Total	1,210,818		1,065,220

5/ Includes water and travel influence zones
6/ Includes areas with high road development costs and a lack of suitable logging methods for steep slopes (>40%)
7/ All of this area is on operable slopes (0-40%)

* See following chart for description of lands unsuitable for timber production.

AREA SUMMARY (continued) Table B-2 Continued

PRODUCTIVE FOREST LAND - NOT SUITED FOR TIMBER PRODUCTION

	PREVIOUS PLAN ACRES	THIS PLAN ACRES
TECHNOLOGICALLY NOT SUITED		
Logging (Slopes Over 70%)	NA*	69,976
Excessive Surface Rock	0	27,824
OTHER BASIS FOR PRODUCTIVE FOREST LANDS NOT SUITED FOR TIMBER PRODUCTION		
Developed Recreation Sites	NA	2,520
Experimental Forests	12,418	12,418 1/
Administrative Sites	NA	2,263
National Recreation Areas	0	0
Back Country	0	0
Endangered Species	0	0
Esthetic Management	0	0
Wildlife Retention	0	0
Wildlife Maintenance	0	0
Market Not Available (Aspen)	133,749	0
Isolated	0	0
High Development Costs	0	0
Suitable Lands Surplus to Timber Production Needs		368,669 2/
Total Unsuitable	146,167	483,670
Total Suitable Lands		581,550

COMPARISON OF TIMBER CHARACTERISTICS

TIMBER SIZE CLASS	COMMERCIAL FOREST ACRES	SUITABLE FOREST ACRES 3/	PERCENT CHANGE
Old Growth Sawtimber 4/	NA	175,941	
Sawtimber (Other)	877,093	445,372	- 49%
Poletimber	495,350	240,839	- 52%
Seed/Sapling	58,167	93,683	+ 61%
Understocked	19,540	109,385	+560%
Nonstocked	0	0	0

1/ Includes productive forest land within Manitou Experimental Forest.

2/ Includes much of the productive forest land on steep slopes (40-70%) and any productive forest land recommended for wilderness classification by the alternative.

3/ Includes productive forest land which is surplus to timber production needs.

4/ Old growth is considered to be 150 years and over for Western National Forests.

* NA = Data not available.

Table B-2 Continued

	PREVIOUS PLAN COMMERCIAL FOREST ACRES	THIS PLAN SUITABLE* FOREST ACRES
FOREST TYPE BY AGE GROUP		
Old Growth (150 yr. +)		
Douglas-fir/White Fir	NA	55,117
Ponderosa Pine	NA	28,723
Lodgepole Pine	NA	5,781
Spruce/Fir	NA	84,529
Aspen	NA	1,791
TOTAL	NA	175,941
Younger Growth		
Douglas-fir/White Fir	333,000	293,797
Ponderosa Pine	341,000	179,843
Lodgepole Pine	193,000	138,748
Spruce/Fir	405,000	150,974
Aspen	178,000	125,917
TOTAL	1,450,000	887,584
GRAND TOTAL	1,450,000	1,065,220
SITE CLASS (Based on Potential Annual Growth)		
20-50 Cf/Ac/Yr	NA	809,971
50-85	NA	255,249
85-120	NA	0
120+	NA	0
AREA OF UNDERSTOCKED BY SITE CLASS		All Forest Land
20 Cf/Ac/Yr	NA	NA
20-50	NA	103,849
50-85	NA	5,536
85-120	NA	0
120+	NA	0
AREA BY CONDITION CLASS		
Overstocked	NA	315,339
Full Stocking	143,000	59,982
Medium Stocking	474,000	488,547
Poor Stocking	634,000	91,967
Understocked	20,000	109,385
AREA PUT UNDER MANAGEMENT BY TYPE (Planned)		AREA PLANNED THIS PERIOD
Douglas-fir/White Fir	6,900	36,000
Ponderosa Pine	15,000	25,500
Lodgepole Pine	22,000	15,100
Spruce/Fir	19,500	14,600
Aspen	Unregulated	3,700

* Including suitable forest land that is surplus to timber production needs.

Table B-2 Continued

	THIS PLAN ON TENTATIVELY SUITABLE FOREST LAND 1/	
	Total Volume	Per Acre 2/
VOLUME COMPARISON 3/		
Growing Stock (G.S.) MMCF	1375	1.25
Salvable Dead MMCF	160	0.15
TOTAL CUBIC VOLUME	1535	1.40
Sawtbr. G.S. MMCF	986	0.90
Sawtbr. G.S. MMBF Scribner	3376	3.08
Sawtbr. G.S. MMBF INT. ¼"	4112	3.75
GROWING STOCK BY STAND SIZE		
Old Growth Sawtbr. MMCF	312	1.72
Younger Sawtbr MMCF	674	1.47
Poletimber MMCF	330	1.34
Seedling/Sapling MMCF	27	0.28
Understocked MMCF	32	0.28
Old Growth Sawtbr. MMBF Scribner 4/	1068	5.89
Younger Wastbr. MMBF Scribner 4/	1680	3.66
SAWTIMBER GROWING STOCK BY TYPE 3/		
Douglas-fir MMBF Scribner	1030	2.86
Ponderosa Pine MMBF Scribner	549	2.55
Spruce/Fir MMBF Scribner	1282	5.28
Lodgepole Pine MMBF Scribner	416	2.83
Aspen MMBF Scribner	98	0.74
POLE TIMBER GROWING STOCK BY TYPE 5/		
Douglas-fir MMCF	150	0.50
Ponserosa Pine MMCF	27	0.16
Spruce/Fir MMCF	129	0.64
Lodgepole Pine MMCF	161	1.18
Aspen MMCF	77	1.03
GROWTH AND MORTALITY ON CFL		
Annual Net Growth MMCF	28.76	26.2
Annual Mortality MMCF	3.22	3.0
Annual Gross Growth MMCF	31.98	29.2

1/ Including tentatively suitable forest land that is surplus to timber production needs.

2/ Per acre values are MCF or MBF

3/ Sawtimber growing-stock trees occur in stands of all size classes. Therefore, the "total volume" and "per acre" values pertain to total sawtimber growing-stock volumes for all tentatively suitable forest land (regardless of calculated stand size).

4/ Volumes for sawtimber size class only (does not include sawtimber growing stock in the poletimber, seedling/sapling or understocked size classes).

5/ Volumes of pole-sized growing stock (5-9" DBH) for tentatively suitable forest land assigned to the sawtimber and poletimber size classes (does not include poletimber growing stock in the seedling/sapling and understocked size classes.

Table B-2 Continued

	THIS PLAN ON TENTATIVELY SUITABLE FOREST LAND	
	Total Volume	Per Acre
ANNUAL GROWING STOCK GROWTH BY STAND SIZE (Net) 1/		
Sawtimber - MMCF	14.87	23.21
Sawtimber MMBF Scribner	62.13	97.00
Poletimber MMCF 2/	7.81	31.67
Seed/Sapling MMCF 2/	3.06	31.67
ANNUAL GROWING STOCK MORTALITY BY STAND SIZE		
Sawtimber - MMCF	6.78	21.64
Sawtimber MMBF Scribner	6.28	9.81
Poletimber MMCF 2/	0.52	2.12
Seed/Saplings MMCF 2/	0.20	2.12
ANNUAL GROWTH BY FOREST TYPE (Net) 3/		
Douglas-fir MMCF	6.78	21.64
Ponderosa Pine MMCF	2.64	15.17
Spruce/Fir MMCF	6.68	29.73
Lodgepole Pine MMCF	6.23	42.68
Aspen MMCF	3.21	25 69
ANNUAL MORTALITY BY FOREST TYPE 3/		
Douglas-fir MMCF	0.88	2.80
Ponderosa Pine MMCF	0.62	3.54
Spruce/Fir MMCF	0.81	3.59
Lodgepole Pine MMCF	0.27	1.82
Aspen MMCF	0.29	2.36

1/ Growing stock used for growth calculations are trees 5" DBH and greater.
2/ Forest inventory data has growth information for poletimber and seedling/sapling size classes combined; therefore, they are shown with the same per acre value.
3/ Growth for growing stock in the sawtimber, poletimber and seedling/sapling size classes only (does not include understocked productive forest lands).

TABLE B-3

AREA SUMMARY BY FOREST TYPE AND SIZE CLASS
(Productive Forest Land In Acres)

Forest Type and Stand Size Class	Previous TM Plan (1962)	Forest Plan (1982) 1/	Percent Change
Douglas-fir/White fir			
Sawtimber	201,000	239,833	+19%
Poletimber	79,000	50,548	-36%
Seedlings/Saplings	-0-	10,695	+
Understocked	-0-	46,931	+
TOTAL	280,000	348,007	+24%
Ponderosa Pine			
Sawtimber	244,000	156,168	-36%
Poletimber	35,000	4,184	-88%
Seedlings/Saplings	3,000	4,840	+61%
Understocked	-0-	41,352	+
TOTAL	282,000	206,544	-27%
Lodgepole Pine			
Sawtimber	48,000	50,428	+ 5%
Poletimber	101,000	89,658	-13%
Seedlings/Saplings	13,000	12,012	- 8%
Understocked	-0-	831	+
TOTAL	162,000	152,929	- 7%
Spruce/Fir			
Sawtimber	236,000	151,115	-36%
Poletimber	81,000	44,042	-46%
Seedlings/Saplings	3,000	13,658	+355%
Understocked	17,000	13,731	-19%
TOTAL	337,000	222,546	-34%
Aspen			
Sawtimber	2,000	23,619	+1081%
Poletimber	119,000	52,554	- 56%
Seedlings/Saplings	29,000	52,478	+ 81%
Understocked	-0-	6,543	+
TOTAL	150,000	135,194	- 10%
Grand Total	1,211,000	1,065,220	- 12%

1/ Includes productive, available forest land surplus to timber production needs.

TABLE B-4

ALLOWABLE SALE QUANTITY AND ANNUAL RPA TARGET STATEMENT

TOTAL PROGRAM COMPONENT AND ACTIVITY	PERIODIC ALLOWABLE SALE QUANTITY Effective FY 85-94 From 10/1/84-9/30/94 AREA ACRES	LARGE ROUNDWOOD (ST) MMBF	LARGE ROUNDWOOD (ST) MMCF	PRODUCTS 1/ MMCF	PRODUCTS 1/ CORDS	TOTAL VOLUME MMCF	ANNUAL RPA TARGET Effective FY 81 - FY 85 AREA ACRES	LARGE ROUNDWOOD (ST) MMBF	LARGE ROUNDWOOD (ST) MMCF	PRODUCTS 1/ MMCF	PRODUCTS 1/ CORDS	TOTAL VOLUME MMCF	TOTAL VOLUME MMBF 2/
FULL YIELD													
Regeneration													
Clearcut	26,600	132 0	41 0	8.2	82,000	49.2	160	1 2	.24	02	250	26	1 3
Seed Cut	52,300	86.9	27.0	5 4	54,000	32 4	3,350	7 2	1 68	17	2,125	1.85	8 3
Selection	16,000 4/	31 9	5 9	1 2	12,000	7 1	560	1.2	28	03	375	31	1.3
Intermediate													
Prep Cut							560	1 2	.28	.03	375	31	1 3
Removal													
Commercial Thin	7,500	5 5	1.7	0 3	3,000	2.0	1,500	1.2	25	03	375	28	1 3
Sub Total-Full Yield	102,400	256 3	75 6	15.1	151,000	90 7	6,130	12.0	2.73	28	3,500	3.01	13.5
Chargeable Allowable Sale Quantity	102,400	256.3	75.6	15 1	151,000	90 7	6,130	12 0	2 73	28	3,500	3 01	13 5
TOTAL	102,400	256 3	75 6	15 1	151,000 3/	90 7	6,130	12 0	2 73	.288	3,500 3/	3 01	13 5

1/ Convertible Products - Converted to cords at 100 cubic feet/cord for control purposes

2/ Includes Convertible Products

3/ This volume is available as topwood and cubic poletimber (5-7" DBH) These were not scheduled outputs and the figures are estimates only

4/ Selection harvest is an expensive method to plan and implement. The method is forecasted to actually be applied between 8,000 and 16,000 acres for the decade. Evaluation of its use will be evaluated periodically through the decade

TABLE B-5

ANNUAL ALLOWABLE SALE QUANTITY AND PROGRAMMED SALE STATEMENT

TOTAL PROGRAM COMPONENT AND ACTIVITY	ANNUAL ALLOWABLE SALE QUANTITY From 10/1/84 - 9/30/94 AREA ACRES	LARGE ROUNDWOOD (ST) MMBF	LARGE ROUNDWOOD (ST) MMCF	PRODUCTS MMCF	PRODUCTS CORDS	TOTAL VOLUME MMCF	PROGRAMMED SALE STATEMENT Fiscal Year 1983 AREA ACRES	LARGE ROUNDWOOD (ST) MMBF	LARGE ROUNDWOOD (ST) MMCF	PRODUCTS MMCF	PRODUCTS CORDS	TOTAL VOLUME MMCF	TOTAL VOLUME MMBF 1/
FULL YIELD													
Clearcut	2,660	13.2	4.1	82	8,200	4 9	1,848	15.30	2 95	0 30	3,750	3 25	17 18
Seed Cut	5,230	8 7	2 7	54	5,400	3.3	3,429	7.51	1 67	0 17	2,125	1.84	8 57
Selection	1,600 3/	3 2	0 6	.12	1,200	0.7							
Prep Cut													
Removal													
Commercial Thin	750	0 6	0.2	03	300	0 2	766	0.95	0 20	0 02	250	0.22	1 08
Sub-Total	10,240	25 7	7 6	1 51	15,100	9.1	6,043	23 76	4 82	0 49	6,125	5 31	26 83
Chargeable Allowable Sale Quantity	10,240	25 7	7 6	1 51	15,100	9 1	6,043	23 76	4 82	0 49	6,125	5 31	26 83
TOTAL ASQ	10,240	25 7	7 6	1 51	15,100 1/	9 1	6,043	23 76	4 82	0 49	6,135	5.31	26.82

PROGRAMMED FROM NON-SUITABLE (Non-Chargeable)

Clearcut	None
Seed Cut	None
Prep Cut	None
Removal	None
Commercial Thin	None
Sub-Total	None
Salvage (Unsuitable)	None

1/ Includes products converted to cords at 100 cubic feet/cord for control purposes

2/ This volume is available as topwood and cubic poletimber (5-7" DBH) These were not scheduled outputs and the figures are estimates only

3/ Selection harvest is an expensive method to plan and implement The method is forecasted to actually be applied to between 800 and 1,600 acres annually Use of the selection harvest system will be periodically evaluated as additional data and experience is gained

TABLE B-6

TIMBERLAND USE CLASSIFICATION AND INVENTORY SUMMARY

	ACRES M ACRES	VOLUME ALL PRODUCTS 5 0" + dbh MMCF	VOLUME LARGE ROUNDWOOD 1/ Scribner MMBF	TOTAL ANNUAL NET GROWTH ALL PRODUCTS 5" + dbh MMCF	TOTAL ANNUAL NET GROWTH LARGE ROUNDWOOD 1/ Scribner MMBF	TOTAL ANNUAL MORTALITY ALL PRODUCTS 5 0" + dbh MMCF	TOTAL ANNUAL MORTALITY LARGE ROUNDWOOD 1/ Scribner MMBF
Water	9 85						
Non-Forest	517 34						
Forest Land	1,697.50						
A. Not Available	264.82	331.03	1,165.21	7.84	23 04	0 56	2.60
Productive Reserved	131 10	163.88	576 84	3 88	11 41	0.28	1 28
Productive Deferred	121 30	151.63	533 72	3 59	10 55	0 25	1 19
Productive Admin Withdrawn	12 42	15 52	54.65	0 37	1 08	0 03	0 13
B Not Suited for Timber Production	851.13	1060 28	3,732.17	25.11	73 80	1.77	8 30
Technologically Not Suited	97.80	122.25	430 32	2 89	8 51	0 21	0 96
Admin Not Suited	4 78	5.98	21 03	0 14	0 42	0 01	0 05
Economically Not Suited	264 89	(NONPRODUCTIVE FOREST LAND)					
Surplus to Tbr. Prod Needs	483 66	601 63	2,117.77	14 25	41.87	1 00	4 70
C Suitable for Tbr. Prod (CFL)	581.55	727 78	2,561 77	17.24	50.66	1.22	5 71
Full Yield	581.55	727.78	2,561 77	17.24	50 66	1.22	5 71
Modified Yield							
SUBTOTAL SUITABLE FOR TBR PROD	581.55	727 78	2,561 77	17 24	50 66	1 22	5 71
NATIONAL FOREST TOTAL	2,224.69	1,788 66 2/	6,296.05 2/	42 36 2/	124.50 2/	3.00 2/	14.02 2/

1/ Sawtimber volumes pertain to trees 9.0" DBH and greater (for which forest inventory data is available)
2/ These totals are for productive forest land only

APPENDIX C

APPENDIX C

SUMMARY OF ARTERIAL, COLLECTOR AND LOCAL ROAD CONSTRUCTION AND RECONSTRUCTION

FY	DISTRICT	ROAD NUMBER	ROAD NAME	TERMINI	ROW NEEDED	DEVELOPMENT LENGTH (miles) CONST	RECONST	ESTIMATED COST M-DOLLARS
84	Leadville	100 1A	Wurtz Crossing	FDR 100-Sec 16	None	0 2		9
84	Salida	346	Ptarmigan	FDR 346-Sec 30	None	0.6	1.9	38
		346 1A	Ptarmigan East	FDR 346-Sec 29	None	0.5		11
84	Salida	200 2A	Beaver Creek	FDR 200-Sec 14	None	2 4		22
84	San Carlos	397	Snowslide	State 165-Sec 15	None	4 1		113
84	Pikes Peak	324	Ice Cave	FDR 300-Sec 4	None		3 5	16
84	Pikes Peak	363	Phantom	FDR 363-Sec 34	None		2 0	20
84	South Park	853	Bonus	FDR 127-FDR 854A	None		2 6	25
		854	Wallace Gulch	FDR 127-FDR 853	None	1 8	2 1	47
84	South Platte	548	Tramway	FDR 543-Green Mtn	None	1 2		16
84	South Platte	545	Wigwam	FDR 545-Sec 29	None	0 9		13
84	South Platte	560 1b	Cabin Ck (Lower)	FDR 560-Sec 23	None	1 7		30
		560 1c	Cabin Ck (Upper)	FDR 560-Sec 9	None	0 8		10
84	South Platte	528	Sixmile	County 126-Sec 1	None	0 6		9
85	Leadville	109	Mt Zion	US24-MP 0 2	1		0 2	5
		109.1A	Zion North	FDR 109-MP 1 0	None	1.0		15
85	Salida	(Name/No to be assigned) Jones Mt TS			None	3 5		55
85	San Carlos	305.2	Willow Creek	Sec 22-Sec 23	None		1 1	10
85	San Carlos	410	Indian Creek	Sec 5-Sec 1	None		2.4	24
85	Pikes Peak	364	Manchester	FDR 357-FDR 363	1		2.0	20
85	Pikes Peak	339	Fisher Wood	State 67-Sec 27	None		0 5	5
85	Pikes Peak	(Name/No. to be assigned) Plum Creek TS			None	1 0		15
85	South Park	134	North Fork	FDR 127-Sec 35	None	2 0	10.6	130
85	South Platte	(Name/No. to be assigned) Sugar Creek TS		FDR 300-Sec 13	None	3.0		60
86	Leadville	109 1A	Zion North	MP 1 0-MP 2 0	None	1 0		15
86	Salida	272 2	Browns Creek	Browns Ck-Sands Ck	None		0.5	10
86	San Carlos	401	Deer Peak	Sec 23-Sec 14	None	1 0	2.4	35
86	Pikes Peak	379 1	Deer Park	FDR 370-W Deer Park	None	2 0	1 0	40
86	South Park	195	Elk Plot	US 285-Sec 36	1		2 2	22
		412	Crooked Creek	FS Bdy-FDR 194	None		1.4	14
86	South Platte	101	Crow Creek	Old US 285-Sec 2	None		3 0	30
86	South Platte	(Name/No. to be assigned)		FDR 211-FDR 560	None	1 0	1 0	30

APPENDIX C

SUMMARY OF ARTERIAL, COLLECTOR AND LOCAL ROAD CONSTRUCTION AND RECONSTRUCTION

FY	DISTRICT	ROAD NUMBER	ROAD NAME	TERMINI	ROW NEEDED	DEVELOPMENT LENGTH (miles) CONST	RECONST	ESTIMATED COST M-DOLLARS
86	South Platte	(Name/No to be assigned)		Brush Creek TS	None	2 0		30
86	South Platte	(Name/No to be assigned)		Dakan Mtn TS	None	1 0		15
87	Leadville	102	E Tennessee	FDR 102-MP 5.0	None	2 0		30
87	Salida	203	Poncha Creek	FDT 1408-FDR 200	None	2 0		30
87	San Carlos	(Name/No. to be assigned)		Gost TS	None	2 4		45
87	San Carlos	(Name/No. to be assigned)		Amethyst TS	None	4 0		88
87	Pikes Peak	(Name/No. to be assigned)		Stone Gulch TS	None		2 0	20
87	Pikes Peak	327.1	Storm Park	FDR 327-Sec 9	None	1 5		25
87	South Park	(Name/No to be assigned)		Michigan Creek TS	None	2 0	2 0	50
87	South Platte	(Name/No to be assigned)		Callahan TS	None	4 0		60
87	South Platte	(Name/No. to be assigned)		Dake Lake TS	None	1 0	0 5	25
88	Pikes Peak	381.1A		FDR 381 1-Mt Rosa	None	1 0		15
88	San Carlos	(Name/No. to be assigned)		Wolf Lake TS	None	2 7		59
88	Pikes Peak	(Name/No. to be assigned)		Catamount TS	None	2.0		35
88	South Park	252	Parker	SH 9-FDR 261	None	1.0	3 5	45
88	South Platte	(Name/No to be assigned)		Thunder Butte TS	None	2 0		30
88	San Carlos	(Name/No. to be assigned)		FDR 403-Sec 30	None	1.0	1 0	60
88	South Platte	(Name/No. to be assigned)		N Elk Creek TS	None	1.5	1 5	40
88	South Platte	(Name/No to be assigned)		Hoosier Creek TS	None	1.0		15
88	South Platte	(Name/No. to be assigned)		Noddles TS	None	2 0		30
89	Leadville	100.1A	Wurtz Crossing	MP 0 2-MP 1 2	None	1.0		15
89	San Carlos	(Name/No. to be assigned)		Pole Creek TS	None	2.0		30
89	South Park	252	Parker	SH 9-FDR 270	1		3 4	35
89	South Park	270	Union	FDR 252-FDR 253	1		3 0	30
89	Pikes Peak	102	Elk Creek	FS Bdy-Sec 10	None	0.5	1 0	45
89	San Isabel	130 3	Lodgepole Flats	FDR 1303-Sec 7	None	1 5		30
89	Pikes Peak	101	Crow Creek	Sec 2-FDR 105	None		3 3	85
89	Pikes Peak	100	Deer Creek	FDR 105-FDR 603	None	3 5		120
90	Pikes Peak	108 2	Harris	FS Bdy-FDR 107	None		2 0	55
90	Pikes Peak	431	Buffalo Peaks	MP 5 6-End	None		3 2	35
		158	Bear Gulch	FDR 431-FDR 442	None		3 0	45
90	San Carlos	300 2	Lake Creek	FS Bdy-Balman Dam	None		3 2	32

APPENDIX C

SUMMARY OF ARTERIAL, COLLECTOR AND LOCAL ROAD CONSTRUCTION AND RECONSTRUCTION

FY	DISTRICT	ROAD NUMBER	ROAD NAME	TERMINI	ROW NEEDED	DEVELOPMENT LENGTH (miles) CONST	RECONST	ESTIMATED COST M-DOLLARS
90	San Carlos	(Name/No to be assigned)		Sec 36-Sec 29	None	3 7	1 3	95
90	Leadville	139	Longs	FDR 131-Sec 19	None	1 0		35
91	Leadville	139 1A	Deckers	FDR 131-Sec 24	None	1 0		35
91	San Carlos	(Name/No. to be assigned)		Sec 9-Sec 29	None	3 0		66
91	San Carlos	321 3	Ditch Creek	Sec 35-Sec 26	None	2 0		44
92	San Carlos	139	Longs	FDR 131-Sec 30	None	1 0		35
92	San Carlos	(Name/No to be assigned)		Sec 3-Sec 4	1 5	0 5	1.5	26
92	San Carlos	(Name/No to be assigned)		Sec 22-Sec 41	None	2 0		44
93	San Carlos	139	Longs	Sec 30-Sec 31	None	1.0		35
93	San Carlos	(Name/No to be assigned)		Sec 15-Sec 17	None	5.0		11 0
93	San Carlos	412	Stanley Creek	Sec 7-Sec 36	3 0	3 0	3 0	96

The fiscal year of construction/reconstruction is planned to coincide with or precede resource management in the respective areas. However, the budget allocation for each year will affect the timing of the actual work

The costs and mileages shown for construction/reconstruction are estimates and were made without the benefit of field data Actual costs and mileages could vary Cost estimates are based on 1978 prices projected to 1985 Engineering costs in support of road design, construction, and right-of-way acquisition costs are not included.

Reconstruction is the upgrading of the standard of an existing road Relocation is considered reconstruction if it replaces the original facility Reconstruction could include removing encroaching vegetation, widening the road surface, upgrading the quantity and quality of drainage structures, upgrading surfacing, reshaping the cut and fill slopes, and dust abatement measures

Construction is building a new road where none currently exists

Projects without a road number and/or name are not currently on the Forest Development Road System. They will be added to the system before funds are expended on the facility.

Bdy Boundary
Ck Creek
Co Rd County Road
FDR Forest Development Road
FDT Forest Development Trail
FS Forest Service
MP Mile Post
Pvt Private
Sec Section
SH State Highway

APPENDIX D

APPENDIX D

SUMMARY OF TRAIL CONSTRUCTION AND RECONSTRUCTION

FY	DISTRICT	TRAIL NAME	TRAIL NUMBER	LOCATION	DEVELOPMENT LENGTH (miles) CONST	RECONST
84	Salida	Horn Fork	1449	Trail 1448 to Bear Lake		2.0
84	San Carlos	Rainbow	1336	Various locations - Custer County	3.0	
84	Leadville	Colorado/Main Range	1776.7	North side Twin Lakes - tie in with south side	2 0	
84	San Carlos	Goodwin	1346	FDT 1336 to Goodwin Lake	5	
84	Pikes Peak	Barr	620	Incline to Manitou Res Trail		2.0
84	South Park	West Jefferson	648	FDR 401-W Jefferson Creek		2 5
84	South Park	Wigwam	609	E. Lost Park		5
84	South Park	Tarryall		Spruce Grove CG - FDT 630	2.4	
84	South Park	Tumble Creek	617	Buffalo Meadows		2
84	South Park	Colorado	1776	3-Mi & Black Canyon	1 5	
84	South Platte	Powerline	690	Indian Creek to Flat Rocks		4 5
84	Pikes Peak	Barr	620	Manitou Res. Trail to Barr Camp		1 9
84	Salida	Kroenke Lake	1448	Upper end to Lake at Browns Pass		2 5
85	San Carlos	Rainbow	1336	Various locations - Custer County		3 0
85	Leadville	Colorado/Main Range	1776	Cache Creek	7	
85	Leadville	Colorado/Main Range	1776	Twin Lakes to Cache Creek		2.3
85	Salida	Hartenstein Lake	1443	Trail to Lake		1 0
85	Salida	Colorado/Main Range	1776	District boundary to N Cottonwood		7
85	Pikes Peak	Barr	620	Barr Camp to FDT 632		9
85	South Park	Puma Hills	656	Wilkerson-Pulver Saddle	3.0	
85	South Park	West Jefferson	648	W Jeff. Cr -FDT 1776	3.8	
85	South Park	Silverheels snowmobile		FDR 412-FDR 405	7 0	
85	Pikes Peak	Waldo Canyon	640	U.S Hwy 24 to loop		2 0
85	South Platte	Powerline	690	Flat Rocks to Devil's Head		2 5
85	South Platte	Dutch Fred	679	Dutch Fred to Jackson Creek		2.0
85	San Carlos	Comanche-Venable	1345	Alvarado CG to Rainbow Trail		1.5
86	San Carlos	Lake of Clouds	1349	Rainbow Trail to Lake		1 0
86	Leadville	Colorado/Main Range	1776	Cache Creek to Clear Creek		2 0
86	Leadville	Colorado/Main Range	1779	Cache Creek ROW includes bridge	0.5	
86	Salida	Bushnell Lake	1402	Upper end of Trail to Lake		.5
86	Pikes Peak	Front Range	-	N Beaver Ck. to S. Beaver	3 0	
86	South Park	11-Mi. Network	-	Various	4 4	
86	South Park	Gold Dust	653	Various	1.0	
86	South Park	Ben Tyler	606	Timberline-Dist Bdy		1 4
86	South Platte	Cabin Ridge	675	Sugar Creek Road to Rampart Range		4.0
86	Leadville	Colorado/Main Range	1776	FDR 104 to Galena Lake Trail		2.4
86	Salida	Stout Creek	1403	Rainbow Trail to Stout Creek Lakes		3.2
86	San Carlos	Horn Creek	1342	Rainbow Trail to Horn Lake	1.0	
87	San Carlos	North Brush	751	Rainbow Trail to Upper Brush Lake		2 0
87	Comanche	Canyons	-	Picture Canyon	3.0	
87	Leadville	North Mt Elbert	1484	FDT 1776 to Summit		3 3
87	Leadville	Colorado/Main Range	1776 7	South Mt Elbert trailhead - north side Twin Lakes	5.0	
87	Salida	Little Cochetopa	1409	FDR 241 to Forest boundary		1.5
87	Salida	Colorado	1776	Angel of Shavano CG to Blank Cabin		1.0
87	San Carlos	Wahatoya	1304	Bulls Eye Road to County line		1.0
87	Pikes Peak	Front Range	-	South Beaver to Hay Creek Road	2.0	
87	South Park	11-Mi Network	-	Various	3.2	
87	South Park	Gold Dust	653	FDR 405-1.0 mi. N	1.0	
87	South Platte	Noddle	677	Sugar Ck Rd. to Rampart (N. end)		3 0
87	South Platte	Lake Park	639	Lake Park to McCurdy Trail		2.5
87	Salida	Tumble Creek/Fourmile	617 2	Buffalo Peaks to Fourmile Creek		1.0
87	Pikes Peak	Putney Gulch	-	Putney Gulch	1 5	
88	San Carlos	Greenhorn	1316	Greenhorn Mountain		1 5
88	Leadville	Turquoise Lake	1493	North shore to May Queen		3 0
88	Pikes Peak	Barr	620	MP 7 7 to MP 10		2 3
88	South Park	11-Mi Network	-	Various	6 5	
88	South Platte	Noddle	677	Complete to Rampart Range		5 5
88	Salida	Pomeroy Lakes	1437	FDR 279 to Lake		1 7
88	Comanche	Canyons	-	Picture Canyon - Sand Canyon	2.2	
88	Salida	Poplar Gulch	1436	St Elmo to Cottonwood Creek		1 5

APPENDIX D

SUMMARY OF TRAIL CONSTRUCTION AND RECONSTRUCTION

FY	DISTRICT	TRAIL NAME	TRAIL NUMBER	LOCATION	DEVELOPMENT LENGTH (miles) CONST	RECONST
89	Salida	Colorado	1776	North Fork to Browns Creek	1.0	
89	Pikes Peak	Waldo Canyon	640	Loop		3 0
89	South Park	Trout Creek	614	Summit		6
89	South Park	11-Mi. Network	-	Various	1 2	
89	South Park	Silverheels snowmobile	-	FDR 405-Boreas	4 5	
89	South Platte	Top of the World	695	First segment SH 67 to Top of the World		7 0
89	San Carlos	St. Charles	1326	SH 165 to Cisneros Trail		2.5
89	Salida	Colorado	1776	FDR 240 to US 50		5
89	Comanche	Canyons	-	Picture Canyon - Sand Canyon	2.8	
89	San Carlos	Tanner	1333	CR 143 to 3/4 mile into Forest		1.5
89	Salida	Browns Creek	1429	FDR 272 - FDR 278		1 5
90	Pikes Peak	Barr	620	MP 100 to Summit		3 3
90	South Park	Puma Hills	653	Pulver Saddle-FDR 250	4.9	
90	South Platte	Flatrock	674	FDT 673 to FDT 675		4 0
90	Comanche	Canyons	-	Picture Canyon - Sand Canyon	2 0	
90	Salida	South Fooses/Colorado	1776	Upper end to S Fooses Creek		1 0
90	San Carlos	Tanner	1333	FS boundary to Oak Creek Grade		2 0
90	South Platte	Russel Gulch	693	Sprucewood to South Platte River		4 0
90	Salida	Pass Creek	1411	FDR 212 - Lake		1.0
90	Salida	Green Creek	1412	FDR 221 - FDT 531		1 5
90	Salida	Rainbow	1336	Various locations		1.5
91	South Park	Platte Springs	619	Canyon Rim-River		0 5
91	South Park	French Pass	631	FDR 400-1 9 to west		1.9
92	South Park	Colorado	1776	S. End Stock Drive 3		
92	South Park	Weston	615	W. Pass CG-O'Look & FDT 616 1.4		
93	South Park	Platte Springs	619	Tarryall Cr End		1 3
93	South Park	Lake Park	639	FDT 607-Dist Bdy		1 0

CG - Campground
Ck - Creek
CR - County Road
FDR - Forest Development Road
FDT - Forest Development Trail
MP - Mile Post
N. - North
Res - Reservoir
S. - South
Seg. - Segment

APPENDIX E

APPENDIX E

ALLOCATION OF CAPABILITY AREAS TO MANAGEMENT AREAS

The Forest has been subdivided into map units for analysis purposes based on homogeniety with respect to environmental characteristics such as vegetation, soils, and slopes. Geographic areas were delineated first to identify areas of political, social, and administrative differentiation. Next, ecological units were identified with respect to potential natural vegetation, the soil and landform type, and unique legal or administrative identifier or number. The geographic and ecological delineations were then combined to identify capability areas. Criteria and coding for the various identifiers are contained in Planning Action 2, Planning Criteria, Pike and San Isabel National Forests, June, 1981.

The management emphasis as shown in the Forest Plan and described in Chapter III, Management Direction, is applied to the capability areas as listed below. Management area delineations are shown in the Forest Plan map and generally follow capability area boundaries. The capability areas are mapped on overlays to USGS 7-1/2 minute topographic guadrangle maps and enable more precise location of management area boundaries. These maps are available for inspection at Ranger District offices and at the Forest Supervisor's headquarters.

Geographic Area	Capability Area Type & I.D.	Number	Management Area
A031	PP080	001	2A
A031	PP100	002	2A
A031	DF080	003	2A
A031	DF08W	004	8B
A032	DF080	001	2B
A033	DF100	001	2A
A033	DF080	002	2B
A033	DF100	003	2A
A034	DF080	002	3A
A034	DF080	003	3A
A034	DF080	004	2A
A034	DF100	005	2B
A034	DF08W	006	8B
A035	DF100	001	2A
A036	PP100	001	2A
A036	PP080	002	2A
A036	DF080	003	2A
A041	SF08W	001	8B
A042	SF08W	801	8B
A042	SF17W	802	8C
A042	SF17W	803	8B
A042	SF17W	803	8B
A042	DF08W	804	8B
A042	SF08W	805	8B
A043	SF14W	001	8B
A043	SF08W	002	8B
A043	SF08W	803	8B
A043	DF08W	804	8B
A043	SF08W	805	8B
A044	PP080	001	PVT
A044	PP080	002	7D
A044	DF080	003	3A
A044	PP100	001	7D
A044	DF080	005	7D
A044	DF100	006	7D
A044	DF10W	007	8B
A044	PP08W	808	8B
A044	DF08W	809	8B
A044	DF08W	810	8B
A051	SF08W	001	8B
A052	PP080	001	2B
A052	PP080	002	2B
A052	PP080	003	2B
A052	PP080	004	2B
A052	PP100	005	2B
A052	PP100	006	2B
A052	PP100	007	2B
A052	PP08W	008	8B
A052	PP080	009	2B
A052	DF080	010	2B
A052	PP100	011	2B
A052	SF08W	012	8B
A053	DF100	001	7A
A053	DF080	002	5B
A053	DF100	003	7A
A053	DF080	004	5B
A053	DF100	005	2B
A053	PP080	006	2B
A054	PP100	001	2B
A054	PP080	002	2B
A054	PP100	003	2B
A054	PP100	004	7A
A054	PP100	005	2B
A054	PP080	006	2B
A054	PP100	007	2B
A054	PP100	008	7A
A055	DF080	001	2B
A055	DF100	002	7A
A055	DF080	003	7A
A055	DF080	004	7A
A055	DF080	005	7A
A055	DF080	006	2B
A056	DF080	001	2B
A056	DF080	002	7A
A056	DF080	003	2B
A056	DF080	004	2B
A056	PP100	005	7A
A056	PP100	006	2B
A056	PP100	007	2B
A056	DF080	008	7A
A056	DF100	009	7A
A056	DF080	010	2B
A056	PP080	011	2B
A057	DF080	001	7D
A057	DF080	002	7D
A057	DF080	003	2B
A057	DF080	004	2B
A057	PP100	005	2B
A057	DF130	006	2B
A058	PP100	001	7D
A058	PP080	002	2B
A058	PP100	003	2B
A058	DF130	004	7A
A058	DF130	005	4B
A058	DF130	006	4B
A058	DF130	007	4B
A058	DF130	008	4B
A058	DF130	009	4B
A058	DF130	010	4B
A058	DF130	011	4B
A061	DF080	001	7A
A061	DF100	002	2B
A061	DF080	003	2A
A061	DF100	004	2B
A061	DF100	005	2A
A061	DF080	006	7A
A061	DF100	007	7A
A061	PP100	008	2A
A062	PP100	001	7A
A062	DF080	002	2B
A062	DF080	003	3A
A062	DF080	004	2B
A062	PP100	005	2B
A062	PP100	006	2A
A062	PP100	007	2B
A071	SF170	001	4D
A071	SF17P	002	7A
A071	AL18P	003	3A
A071	AL18P	004	3A
A071	SF17P	005	4B
A071	SF170	006	2B
A071	SF170	007	5B
A071	SF160	008	4D
A071	SF160	009	5B
A071	SF170	010	5B
A071	SF170	011	2B
A071	SF170	012	4B
A071	AL190	013	4B
A071	SF170	014	2B
A071	SF170	015	2B
A071	SF170	016	2B
A071	AL190	017	4B
A071	SF170	018	2B
A071	SF170	019	2B
A071	AL190	020	4B
A071	SF170	021	2B
A071	SF170	022	5B
A072	SF170	001	2B
A072	AL190	002	4B
A072	SF170	003	4B
A072	AL190	004	4B
A072	AL190	005	4B
A073	SF170	001	2B
A073	SF160	002	5B
A073	SF170	003	2B
A073	SF170	004	1B-1
A073	SF170	005	1B-1
A073	SF160	006	2B
A073	SF170	007	2B
A073	SF170	008	2B
A073	SF170	009	4B
A073	SF170	010	4B
A073	AL190	011	4B
A073	SF170	012	7A
A074	AL190	001	2B
A074	AL18W	003	8C
A074	AL19W	802	8B
A075	SF170	001	2B
A075	SF17W	002	8B
A075	SF17W	003	8B
A075	AL18W	004	8B
A075	SF17W	005	8B
A075	AL18W	006	8B
A075	AL19W	807	8B
A091	SF17W	001	8B
A091	LP17P	002	5B
A091	SF17P	003	3A
A091	SF17P	004	4B
A091	SF170	005	2B
A091	PP160	006	2B
A091	PP160	007	2B
A091	LP170	008	5B
A091	SF170	009	2B
A091	SF170	010	2B
A091	SF17W	011	8B
A091	AL19W	012	8B
A092	PP170	001	2B
A092	LP17W	002	8B
A092	LP17W	003	8B
A092	SF17W	004	8B
A092	SF17W	005	8B
A092	PP170	006	5B
A092	LP170	007	5B
A092	PP160	008	2B
A092	LP170	009	5B
A092	PP170	010	5B
A092	LP170	011	5B
A093	DF170	001	2B
A093	SF17W	002	8B
A093	SF17W	003	8B
A093	SF17W	004	8B
A093	DF17W	005	8B
A093	PP17W	006	8B
A093	LP17W	007	8B
A093	DF170	008	2B
A093	PP170	009	2B
A111	LP170	001	2B
A111	LP160	002	2B
A111	LP170	003	2B
A111	SF170	004	2B
A111	SF16W	005	8B
A111	AL19W	006	8B
A111	SF17W	007	8C
A111	SF17W	008	8C
A111	AL19W	009	8B
A112	LP080	001	7D
A112	LP080	002	7D
A112	LP170	003	7D
A112	LP160	004	7D
A112	SF170	005	7D
A112	LP080	006	7D
A112	LP080	007	7D
A112	LP160	008	7D
A112	SF160	009	2A
A112	SF170	010	2A
A112	SF160	011	2B
A112	SF17W	012	8B
A113	PP100	001	2B
A114	PP100	001	7A
A114	PP100	002	7A
A114	PP080	003	7A
A114	PP080	004	7A
A114	PP080	005	9B
A114	PP080	006	2B
A114	PP080	007	2B
A131	SF08W	001	8B
A131	DF08W	002	8B
A131	DF080	003	2B
A132	SF08W	001	8B
A132	DF08W	002	8B
A132	PP100	003	7A
A132	DF080	004	7A
A132	DF080	005	7A
A132	DF080	006	2B
A132	PP100	007	2B
A132	PP080	008	2B
A132	PP100	009	2B
A132	PP080	010	2B
A132	PP080	011	2B
A132	PP100	012	2B
A132	PP100	013	2B
A151	DF080	001	4B
A151	DF080	002	4B
A151	DF080	003	2B
A151	DF100	004	7D
A151	DF100	005	7D
A151	DF080	006	4B
A151	DF080	007	4B
A152	DF100	001	2B
A152	DF080	002	2B
A152	DF080	003	2B
A152	DF080	004	7D

Geographic Area	Capability Area Type & I.D.	Number	Management Area
A152	DF080	005	2B
A152	DF100	006	2B
A152	PP100	007	7D
A152	PP080	008	7A
A152	DF100	009	2B
A152	PP100	010	2B
A152	DF130	011	2B
0011	SF170	001	2A
0011	AL190	002	6B
0011	SF170	003	2B
0011	SF170	004	2B
0011	SF160	005	2B
0011	SF170	006	6B
0011	AL190	007	6B
0011	A1190	008	6B
0011	SF170	009	6B
0011	AL190	010	6B
0011	SF170	011	2B
0011	SF170	012	2A
0011	SF160	013	2B
0011	SF160	014	4B
0012	SF170	001	9B
0012	SF160	002	2B
0012	SF170	003	9B
0012	AL190	004	9B
0012	AL190	005	9B
0012	AL190	006	9B
0012	SF170	007	9B
0013	SF160	001	2B
0013	SF160	002	5B
0013	SF160	003	6B
0013	SF160	004	6B
0013	SF170	005	2B
0013	SF170	006	2B
0013	AL190	007	4B
0013	SF170	008	3A
0013	SF170	009	3A
0021	SF170	001	7A
0021	SF170	002	7A
0021	SF17W	003	8B
0021	SF17W	004	8B
0021	AL19W	005	3A
0021	SF17W	006	3A
0021	SF150	007	3A
0021	SF150	008	5B
0021	SB160	009	5B
0021	SF160	010	5B
0021	FM160	011	5B
0021	SF160	012	6B
0021	SF160	013	6B
0021	SF150	014	6B
0021	SF17P	015	3A
0021	SF17P	016	3A
0021	AL18P	017	3A
0022	SB160	001	6B
0022	DF150	002	6B
0022	SB160	003	6B
0022	SB160	004	6B
0022	SF160	005	6B
0022	SF170	006	4B
0022	SF170	007	4B
0022	DF170	008	4B
0022	DF150	009	5B
0022	SB160	010	5B
0022	SF150	011	5B
0023	SF150	001	7A
0023	SF160	002	6B
0023	SB160	003	6B
0023	SF150	004	6B
0023	SF160	005	4B
0023	SF150	006	4B
0023	SB160	007	4B
0023	SF150	008	4B
0023	SF150	009	3A
0023	SB150	010	6B
0023	SB160	011	5B
0023	DF160	012	4B
0023	SB160	013	6B
0031	PP100	001	2B
0031	DF100	002	2B
0031	DF100	003	4B
0031	DF100	004	2B
0031	DF080	005	2B
0032	DF100	001	2A
0032	PP080	002	2A
0033	PP080	001	2A
0041	SF17W	001	8B
0041	SF16W	002	8B
0041	SF170	003	7A
0041	SF160	004	7A
0041	SF160	005	6B
0041	SF17W	006	8B
0041	AL18W	007	8B
0042	SF17W	001	8B
0042	SF16W	002	8B
0042	SF17W	003	8B
0042	SF160	004	7A
0042	SF160	005	6B
0042	SF170	006	7A
0042	SF160	007	7A
0042	SF170	008	7A
0043	SF17W	001	8B
0043	SF08W	002	8B
0043	SF16W	003	8C
0043	SF08W	004	8B
0043	SF17W	005	8C
0081	DF080	001	4B
0081	DF140	002	2B
0081	DF150	003	4B
0081	SF150	004	4B
0081	DF150	005	4B
0081	PP140	006	2B
0081	FM140	007	2B
0081	SF080	008	5B
0081	FM140	009	6B
0081	SF150	010	5B
0081	SF150	011	4B
0081	DF140	012	6B
0081	DF080	013	4B
0081	DF150	014	6B
0081	SF150	015	4B
0081	DF160	016	6B
0082	SF120	001	6B
0082	FM110	002	6B
0082	SF120	003	6B
0082	FM110	004	6B
0082	FM120	005	6B
0082	SF120	006	7A
0082	SF110	007	7A
0082	FM110	008	6B
0082	SF120	009	4B
0082	FM110	010	6B
0082	DF120	011	6B
0082	SF120	012	7A
0082	SF120	013	6B
0082	DF120	015	4B
0082	FM110	016	6A
0082	PP110	017	4B
0082	SF120	914	10A
0083	DF120	001	2B
0083	PP120	002	2B
0083	PP110	003	2B
0083	PP080	004	4B
0083	PP140	005	4B
0083	PP080	006	2B
0083	PP080	007	2B
0083	PP140	008	2B
0083	DF080	009	2B
0083	DF080	010	4B
0084	DF110	001	7D
0084	PP110	002	7D
0084	PP120	003	7D
0084	PP080	004	7D
0084	PP140	005	7D
0084	PP100	006	2B
0084	PP140	007	2B
0085	PP140	001	7D
0091	SF17W	001	8B
0091	AL18W	002	8B
0091	SF16W	003	8B
0091	SF18W	004	8B
0091	SF17W	005	8B
0211	BP110	001	4B
0211	SF120	002	4B
0211	PP120	003	7D
0211	PP110	004	2B
0221	FM110	001	6B
0221	BP120	002	6B
0221	SF120	003	6B
0221	BP120	004	5B
0221	FM110	005	6B
0221	SF120	006	5B
0221	FM120	007	6B
0221	BP120	008	4B
0231	SF08W	001	8C
0231	DF080	003	5B
0231	DF140	004	5B
0231	SF17W	005	8B
0231	DF170	007	5B
0231	DF150	008	2B
0231	SF150	009	4B
0231	SF150	010	4B
0231	SF150	011	3A
0231	DF150	012	3A
0231	SF150	013	3A
0231	SF150	014	3A
0231	DF170	015	5B
0231	DF17W	016	8B
0231	SF17W	017	8B
0231	SF170	018	5B
0231	SF17W	019	8B
0231	SF08W	802	8C
0231	SF17W	806	8B
0232	SF08W	001	8B
0232	DF080	002	5B
0232	PP140	003	2B
0232	PP140	004	2B
0232	PP140	005	2B
0232	PP140	006	6B
0232	PP140	007	2B
0232	PP140	008	2B
0232	PP080	009	5B
0233	PP140	001	2B
0233	DF080	002	2A
0233	PP080	003	2A
0233	DF080	004	2B
0233	PP080	005	2B
0233	PP140	006	6B
0233	PP080	007	2B
0233	PP150	008	6B
0233	PP150	009	6B
0233	SF080	010	5B
0233	SF140	011	5B
0233	PP150	012	6B
0233	PP140	013	5B
0233	PP150	014	6B
0233	PP150	015	6B
0233	PP140	016	2B
0233	SF08W	017	8B
0251	DF150	001	4B
0251	PP140	002	2B
0251	PP140	003	2B
0251	PP140	004	2B
0252	DF150	001	2B
0252	PP140	002	5B
0252	PP150	003	2B
0252	PP140	004	2B
0252	PP140	005	5B
0252	PP140	006	2B
0252	PP150	007	2B
0252	PP080	008	2B
0252	SF150	009	2B
0252	DF150	010	2B
0253	PP140	001	2B
0253	PP080	002	2B
0253	PP080	003	2B
0253	PP080	004	2B
0253	DF080	005	2A
0254	DF080	001	2A
0254	DF100	002	2A
0254	DF080	003	2A
0254	DF080	004	2A
0254	PP080	005	2A
0254	DF100	006	2A
0811	FM120	001	5B
0811	SF120	002	5B
0811	SF110	003	6B
0811	FM110	004	6B
0811	FM120	005	6B
0981	SF140	001	5B
0981	SF170	002	9B
0981	SF170	003	2B

Geographic Area	Capability Area Type & I.D.	Number	Management Area
0981	SF170	004	5B
0981	AL190	005	2B
0982	SF140	001	7D
0982	AL190	002	4B
0982	SF140	003	4B
0982	SF140	004	4B
0982	SF170	005	9B
0982	SF170	006	9B
0982	AL190	007	4B
0983	AL19P	001	8B
0983	SF17P	002	8B
0983	SF09P	003	8B
0983	SF17P	004	8B
0983	SF19P	005	8B
0983	SF17P	006	8B
0983	SF170	007	6B
0983	SF170	008	6B
0983	SF17P	009	6B
0983	DF140	010	5B
0983	SF140	011	6B
0983	SF140	012	6B
0983	SF170	013	2B
0983	SF170	014	2B
0983	SF17P	015	8B
0983	AL19P	016	8B
0983	AL190	017	2B
0983	AL190	018	4B
0984	DF140	001	6B
0984	DF140	002	5B
0984	FM110	003	5B
0984	DF110	004	6B
0984	SF14P	005	6B
0984	SF140	006	6B
0984	SF14P	007	9B
0984	AL19P	008	8B
0984	SF17P	009	6B
0984	SF140	010	7D
0984	SF140	011	7D
0984	DF140	012	7D
0984	PP140	013	5B
0984	DF140	014	5B
0984	FM110	015	6B
0991	SF170	001	2B
0991	AL190	002	2B
0991	SF170	004	2B
0991	SF170	006	2B
0991	AL190	007	2B
0991	AL190	008	2B
0991	AL190	009	2B
0991	AL190	010	2B
0991	SF170	805	2B
0992	SF170	001	2B
0992	AL190	002	2B
0992	SF170	003	2B
0992	AL190	004	2B
0992	AL190	005	2B
0992	SF170	007	2B
0993	SF110	001	10E
0993	SF110	002	2B
0993	SF170	003	10E
0993	SF170	004	10E
0993	SF170	005	10E
0993	AL190	006	10E
0993	AL190	007	10E
0994	FM160	001	5B
0994	SF160	002	4B
0994	SF190	003	4B
0994	AL190	004	4B
0994	SF170	005	4B
0994	SF170	006	5B
0994	SF110	007	5B
0994	SF160	008	5B
1291	AL190	001	2B
1591	AL190	001	3A
1591	AL190	002	3A
1591	SF170	003	2A
1591	SF090	004	2B
1591	AL190	005	2B
1591	SF170	006	2A
1591	AL190	007	2A
1591	AL190	008	2A
1591	SF190	009	2A
1592	SF170	001	2A/1B-1
1592	AL190	002	2A
1592	AL190	003	2A/1B-1
1592	SF170	004	2A/1B-1
1592	SF160	005	2A/1B-1
1592	SF160	006	2B
1592	SF160	007	4D
1592	SF160	008	5B
1592	FM070	009	2B
1593	SF160	001	4D/1B-1
1593	SF160	002	7D
1593	SF160	003	7D
1593	SF160	004	2B
1593	SF160	005	2B
1593	SF160	006	2B
1593	SF170	007	2B
1593	SF17W	008	8C
1593	AL19W	009	8C
1593	SF170	010	2B
1593	SF16W	011	8C
1593	AL19W	012	8C
1593	AL190	013	2B
161F	SF16W	001	8C
161F	AL19W	002	8B
1611	SF160	001	2B
1611	SF160	002	2B
1611	SF170	003	2B
1611	SF170	004	2B
1611	SF17W	005	8C
1611	AL19W	006	8C
1611	AL19W	007	8C
1611	SF17W	008	8C
1611	SF170	009	2B
1611	AL190	010	2B
1611	SF170	011	2B
1611	SF170	012	2B
1611	SF160	013	2B
1611	SF17W	014	8C
1611	AL19W	015	8C
1612	SF160	001	2B
1612	SF17W	002	8C
1612	SF17W	004	8B
1612	AL19W	005	8B
1612	AL19W	006	8B
1612	AL19W	007	8C
1612	AL19W	008	8B
1612	SF16W	009	8C
1612	SF16W	010	8C
1612	SF160	011	2B
1613	SF160	001	2B
1613	SF17W	002	8C
1613	AL19W	003	8B
1613	AL19W	004	8B
1613	AL19W	005	8B
1613	AL190	006	3A
1613	AL190	007	3A
1613	SF170	008	2A
1613	SF170	009	2A
1613	SF170	010	2A
1631	AL19P	001	6B
1631	SF17P	002	2B
1631	SF170	003	7D
1631	AL190	004	3A
1631	AL190	005	3A
1631	SF160	006	7D
1631	SF170	007	7D
1631	SF170	008	7D
1631	SF160	009	5B
1632	SF160	001	5B
1632	SF160	002	4B
1632	SF160	003	4B
1632	SF170	004	3A
1632	AL190	005	3A
1633	AL19P	001	8B
1633	SF17P	002	4D
1633	SF08P	003	4B
1633	SF170	004	4D
1633	SF160	005	4D
1633	SB160	006	5B
1633	SF170	007	5B
1651	AL190	001	3A
1651	AL190	002	3A
1651	AL19W	003	8B
1651	AL190	004	2B
1651	SF170	005	2B
1651	AL190	006	3A
1651	SF170	007	2B
1651	SF17W	008	8C
1651	AL19W	009	8C
1651	AL19W	010	8C
1651	AL190	011	2B
1652	SF170	001	2A
1652	AL190	002	2A
1652	AL19W	003	8C
1652	AL19W	004	8C
1652	AL19W	005	8C
1652	AL19W	006	8C
1652	AL190	007	2A
1652	AL19W	008	8C
1652	SF170	009	2A
1653	SF170	001	3A
1653	AL190	002	3A
1653	AL19W	003	8B
1653	SF17W	004	8B
1653	SF170	005	3A
1653	AL190	006	3A
1654	SF160	001	2B
1654	SF090	002	2B
1654	SF170	003	1B-2
1654	SF160	004	2B
1654	SF170	005	3A
1654	SF17W	006	8B
1654	SF170	007	2B
1654	SF170	008	3A
1654	AL190	009	3A
1654	SF170	010	2B
1671	SF170	001	2A
1671	AL190	002	2A
1671	AL19W	003	8C
1671	SF17W	004	8C
1671	AL19W	005	8C
1671	SF17W	006	8C
1671	AL190	007	3A
1671	AL190	008	2A
1672	SF17W	001	8B
1672	SF170	002	2B
1672	SF090	003	2B
1672	SF17W	004	8B
1672	AL19W	005	8B
1672	AL19W	006	8B
1672	SF17W	007	8C
1672	SF170	008	2B
1672	SF170	009	2B
1672	AL190	010	3A
1672	SF170	011	5B
1672	SF170	012	5B
1672	SF160	013	1B-2
1672	SF190	014	3A
1673	AL19P	001	8B
1673	AL19P	002	8B
1673	SF17P	003	7D
1673	SF170	004	5B
1673	SF170	005	5B
1673	SF08P	006	4B
1674	SF170	001	5B
1674	SF17P	002	8B
1674	AL19P	003	8B
1691	SF160	001	5B
1691	SF170	002	4B
1691	SF170	003	4B
1691	SF17W	004	8C
1691	SF17W	005	8C
1691	AL19W	006	8B
1692	SF160	001	5B
1692	SF170	002	4B
1692	SF17W	003	8C
1692	AL19W	004	8B
1693	SF160	002	5B
1693	SF17W	003	8C
1693	AL19W	004	8B
1693	SF170	005	5B
1694	PJ090	001	5B
1694	PJ070	002	5B
1694	SF17P	003	8B
1694	SF170	004	5B
1694	SF17P	005	5B
2711	PP050	001	5B
2711	SF170	002	5B
2711	SF190	003	3A
2711	SF170	004	2B

Geographic Area	Capability Area Type & I.D.	Number	Management Area
2711	AL19W	005	8B
2711	SF17W	006	8C
2711	AL19W	007	8B
2711	SF19W	008	8C
2712	PJ170	001	5B
2712	SF170	002	2B
2712	SF170	003	5B
2712	SF170	004	4B
2712	AL190	005	4B
2712	AL190	006	8B
2712	SF170	007	9B
2712	AL19W	008	8B
2712	AL19W	009	8B
2712	SF17W	010	8B
2712	SF17W	011	8C
2712	SF19W	012	8C
2713	DF170	001	5B
2713	SF170	002	9B
2713	AL190	003	4B
2713	AL190	004	4B
2713	SF170	005	9B
2713	SF170	006	9B
2713	AL190	007	4B
2713	SF170	008	9B
2713	AL190	009	4B
2713	SF170	010	9B
2713	SF170	011	2B
2713	SF170	012	5B
2731	DF140	001	5B
2731	DF140	002	5B
2731	PJ090	003	5B
2731	PJ090	004	4B
2731	DF140	005	4B
2731	SF140	006	4B
2731	SF140	007	4B
2731	SF14P	008	5B
2731	DF17P	009	5B
2731	DF140	010	5B
2731	SF17P	011	5B
2731	SF17P	012	8B
2731	AL19P	013	8B
2732	FM110	001	6B
2732	DF080	002	6B
2732	DF080	003	6B
2732	PJ140	004	2B
2732	DF080	005	2B
2732	PJ140	006	4B
2732	DF090	007	4B
2732	FM090	008	2B
2732	DF090	009	2B
2732	DF090	010	4B
2732	DF080	011	2B
2732	DF140	012	6B
2732	DF140	013	6B
2732	SF090	014	4D
2733	DF110	001	6B
2733	DF110	002	6B
2733	FM110	003	6B
2733	DF080	004	6B
2733	DF110	005	6B
2733	PP140	006	6B
2733	PP110	007	6B
2733	PP080	008	6B
2733	DF080	009	6B
2734	DF110	001	6B
2734	DF080	002	6B
2734	PJ110	003	4B
2734	DF110	004	4B
2734	PP090	005	6B
2734	PJ080	006	6B
2735	SF170	002	5B
2735	DF170	003	5B
2735	AL190	004	4B
2751	SF170	001	2A
2751	AL190	002	4B
2751	A1190	003	2A
2751	AL190	004	2A
2752	AL190	001	2A
2752	SF170	002	2B
2752	SF170	003	9B
2752	AL190	004	4B
2752	SF170	005	2B
2752	SF170	006	9B
2752	AL190	007	2A
2753	PP070	001	2B
2753	SF170	002	5B
2753	DF170	003	5B
2753	SF170	004	4B
2753	AL190	005	4B
2753	AL190	006	4B
2753	AL190	007	2A
2753	SF170	008	4B
2753	SF170	009	3A
2753	AL190	010	4B
2753	AL190	011	4B
2753	SF170	012	4D
2753	SF170	013	4D
2753	AL190	014	4B
2771	DF110	001	4D
2771	DF080	002	4D
2771	FM110	003	6B
2771	PP110	004	6B
2771	PP080	005	6B
2771	PJ110	006	5B
2771	PJ110	007	5B
2771	PP080	008	6B
2771	PP110	009	6B
2772	PP050	001	7D
2772	DF050	002	7D
2772	SF170	003	7D
2772	SF170	004	7D
2772	AL190	005	4B
2772	SF170	006	4B
2772	AL190	007	4B
2772	AL190	008	4B
2773	PJ050	002	7A
2773	DF050	003	7A
2773	SF170	004	4B
2773	PP050	005	7D
2774	PP050	001	7A
2774	DF050	002	7A
2774	SF170	003	7A
2774	AL190	004	4B
2775	PJ080	001	5B
2775	PJ110	002	5B
2775	DF090	003	6B
2775	DF110	004	5B
2775	PJ080	005	6B
2775	PJ080	006	6B
2775	DF110	007	6B
2775	DF110	008	6B
2775	DF110	009	6B
2775	DF080	010	6B
2775	DF110	011	2B
2775	DF110	012	5B
2775	DF110	013	5B
2775	PJ110	014	5B
2775	DF080	015	5B
2775	DF080	016	4D
2776	PJ080	001	5B
2776	DF080	002	5B
2776	DF080	003	6B
2776	PJ080	004	5B
2776	DF080	005	6B
2776	PJ080	006	5B
2776	DF080	007	6B
2776	DF080	008	6B
2791	SF190	001	2B/1B-1
2791	SF190	002	1B
2791	SF170	003	2B
2791	SF170	004	2B
2791	AL190	005	4B
2791	SF170	006	2B
2791	AL190	007	4B
2791	SF170	008	4B
2791	AL190	009	4B
2791	SF170	010	4D
2791	SF170	011	4D
2791	SF170	012	2B
2791	SF170	013	2B
2791	DF170	014	5B
2791	FM050	015	5B
2791	DF050	016	5B
2792	AL190	001	5B
2792	SF190	002	9B
2792	AL190	003	9B
2792	SF190	004	9B
2792	SF170	005	7D
2792	SF170	006	9B
2792	SF170	007	7D
2793	AL190	001	3A
2793	SF190	002	2A
2793	AL190	003	5B
2793	SF170	004	2A
2793	SF170	005	2A
2793	DF170	006	5B
2793	PJ170	007	5B
2793	SF170	008	2A
2793	DF170	009	2A
2793	DF050	010	5B
2793	DF170	011	5B
2793	DF170	012	5B
2794	DF050	001	5B
2794	DF170	002	2B
2794	PP050	003	7A
2794	SF170	004	2B
2794	AL190	005	4B
2794	SF170	006	2B
2794	AL190	007	4B
2794	SF170	008	2B
2794	AL190	009	4B
2795	DF170	001	5B
2795	DF170	002	5B
2795	DF170	003	5B
2795	SF170	004	9B
2795	SF170	005	2A
2795	AL190	006	3A
2795	AL190	007	3A
2796	AL170	001	9B
2796	SF170	002	9B
2796	SF170	003	9B
2796	DF170	004	2B
2796	DF170	005	2B
2796	SF170	006	9B
2796	SF170	007	9B
2796	SF170	008	9B
2796	SF170	009	9B
2796	SF170	010	9B
2796	DF170	011	2B
2796	DF170	012	4D
2796	SF170	013	2B
2796	SF170	014	2B
2796	AL190	015	3A
2696	DF170	016	6B
2797	DF170	001	5B
2797	SF170	002	2A
2797	DF080	003	5B
2797	DF080	004	2A
2797	SF170	005	2A
2797	DF170	006	5B
2797	DF170	007	5B
2797	DF170	008	5B
2797	DF170	009	6B
2797	DF170	010	4D
2797	DF170	011	4D
2797	SF170	012	9B
2797	AL190	013	3A
2811	FM110	001	6B
2811	PP080	002	6B
2811	PP080	003	6B
2811	PP080	004	4D
2811	DF110	005	4D
2811	PP080	006	4D
2811	PP080	007	4D
2811	FM110	008	6B
2811	PP080	009	6B
2811	FM110	010	6B
2811	DF080	011	6B
2811	DF110	012	6B
2811	PP110	013	6B
2811	DF110	014	6B
2811	FM110	015	6B
2812	FM110	001	6B
2812	PP080	002	6B
2812	PP110	003	6B
2812	FM110	004	6B
2812	PP080	005	4D
2812	DF110	006	4D
2813	PJ080	001	5B
2813	DF080	002	5B
2813	DF080	003	5B
2813	DF080	004	6B
2813	PJ080	005	6B
2813	DF080	006	6B
2813	DF110	007	6B
2813	DF080	008	6B

Geographic Area	Capability Area Type & I.D.	Number	Management Area
2813	PJ080	009	5B
2813	DF080	010	6B
2813	DF080	011	6B
2813	PJ080	012	5B
2813	PJ080	013	5B
2813	PJ080	014	5B
2813	DF080	015	6B
2813	FM110	016	6B
2813	FM110	017	6B
2813	DF110	018	6B
2831	DF030	001	5B
2831	SF170	002	2A
2832	DF030	001	5B
2832	SF060	002	4B
2832	SF06P	003	8B
2832	AL06P	004	8B
2832	SF060	005	2A
2832	*DF030*	*006*	4B
2833	DF030	001	4B
2833	SF05P	002	8B
2833	AL06P	003	8B
2833	SF06P	004	8B
2833	DF03P	005	8B
2833	DF030	006	4B
2833	DF060	007	4B
2834	DF030	001	4B
2834	SF06P	002	8C
2834	SF01P	003	8C
2834	AL01P	004	8C
2834	AL06P	005	8B
2834	SF05P	006	8B
2934	SF03P	007	8B
2834	SF06P	008	8B
2834	DF05P	009	8C
2834	DF050	010	7A
2835	SF01P	001	8B
2835	DF06P	002	8B
2835	DF060	003	2A
2835	DF060	004	2B
2835	DF050	005	2A
2835	DF05P	006	8B
2835	SF06P	007	8B
2835	AL06P	008	8B
2835	SF06P	009	8B
2836	DF06P	001	8B
2836	DF01P	002	8B
2836	PJ010	003	5B
2836	DF010	004	7A
2836	DF06P	005	8B
2836	SF01P	006	8B
2836	DF06P	007	8B
2836	*DF01P*	*008*	8B
2836	DF060	009	2A
2837	SF06P	001	8B
2837	AL06P	002	8B
2837	SF01P	003	8B
2981	DF110	001	6B
2981	FM110	002	6B
2981	DF080	003	6B
2981	DF110	004	6B
2981	DF140	005	2B
3831	DF010	001	7A
3831	DF01P	*002*	8B
3841	DF010	001	7A
3841	SF010	002	7D
3841	SF060	003	2A
3841	AL060	004	3A
3841	SF050	005	2A
3841	SF060	006	2A
3841	SF050	007	3A
3841	SF010	008	2A
3841	SF06P	009	8B
3842	DF050	001	7A
3842	SF06P	002	8B
3842	AL06P	003	8B
3842	SF06P	004	3A
3842	SF06P	005	8B
3842	DF05P	006	7A
3842	SF05P	007	2A
3842	AL06P	008	8B
3842	SF06P	009	2A
3843	*SF01P*	*001*	7A
3843	DF050	002	7A
3843	DF05P	003	7A
3843	SF06P	004	8B
3843	AL06P	005	8B
3851	DF060	001	1B-1
3851	AL060	002	2A
3851	SF010	003	2A
3851	SF060	004	2A
3851	DF060	005	1B-1
3851	SF06P	006	8C
3851	SF060	007	2A
3851	SF060	008	4D
3851	AL06P	009	8C
3851	SF06P	010	8C
3851	SF01P	011	8C
3851	SF06P	012	8C
3851	DF050	013	2A
3851	AL06P	014	8C
3852	AL06P	001	8B
3852	SF06P	002	2A
3852	SF060	003	7A
3852	SF06P	004	2A
3852	DF06P	005	7A
3852	SF01P	006	8B
3852	DF010	007	2B
3852	SF06P	008	4B
3852	SF01P	009	2A
3852	AL06P	010	8B
3852	AL06P	011	2A
3852	SF06P	012	2A
3853	DF030	001	7A
3853	SF06P	002	7A
3853	DF060	003	7A
3853	SF060	004	2A
3853	AL06P	005	8C
3853	SF06P	006	7A
3853	SF060	007	7A
3853	SF030	008	2A
3853	AL06P	009	8B
3853	SF06P	010	8B
3854	SF030	001	6B
3854	SF030	002	6B
3854	DF050	003	6B
3854	DF050	004	6B
3854	*SF010*	*005*	6B
3854	SF030	006	6B
3855	PP050	001	5B
3855	PJ030	002	5B
3855	DF060	003	5B
3855	PJ060	004	5B
3855	DF060	005	5B
3855	PJ060	006	5B
3871	DF060	001	5B
3871	DF060	002	5B
3871	DF050	003	5B
3872	PP060	001	2A
3872	DF060	002	2A
3872	PP060	003	2A
3872	DF030	004	4B
3872	PP050	005	4B
3872	PP060	006	4B
3872	PJ050	007	4B
3872	PP060	008	4B
3872	*DF030*	*009*	4B
3872	DF050	010	5B
3873	PP060	001	5B
3873	DF060	002	5B
3873	DF030	003	7A
3873	DF010	004	7A
3874	DF060	001	2A
3874	DF060	002	2A
3874	DF030	003	7A
3874	DF050	004	7A
3874	DF030	005	7A
3874	*DF060*	*006*	7A
3874	DF010	007	7A
3875	SF030	001	9B
3875	DF060	002	4B
3875	DF060	003	5B
3875	DF060	004	5B
3875	DF060	005	5B
3875	DF060	006	2A
3875	DF060	007	2A
3875	DF060	008	2B
3875	PP030	009	2A
3875	DF060	010	2A
3875	DF060	011	2A
3875	SF030	012	7A
3875	DF060	013	2B
3875	SF050	014	7A
3875	DF060	015	2A
3875	PP040	018	2B
3876	DF040	001	5B
3876	PP040	002	5B
3876	PP030	003	5B
3877	PP030	001	7D
3877	PP040	002	7D
3877	PP030	003	7D
3877	DF040	004	7D
3877	PP010	005	7D
3877	PP060	006	7D
3877	PP030	007	7D
3890	PP030	001	7D
3890	PP050	002	2B
3890	PP060	003	2B
3891	DF060	001	2B
3891	DF050	002	7A
3891	DF060	003	7A
3891	PP060	004	5B
3892	DF060	001	2B
3892	DF060	002	2B
3892	DF050	003	2B
3892	DF050	004	2B
3892	DF050	005	7A
3892	DF050	006	2B
3892	SF050	007	9B
3892	SF050	008	9B
3892	SF030	009	7A
3892	SF050	010	7A
3893	SF060	001	7A
3893	SF030	002	9B
3893	SF050	003	6B
3893	SF060	004	7A
3893	DF050	005	2B
3893	DF050	006	2B
3893	DF030	007	2B
3893	DF050	008	2B
3893	SF050	009	6B
3893	SF020	010	9B
3893	SF020	011	9B
3894	DF060	001	5B
3894	DF06P	002	8B
3894	SF06P	003	8B
3894	AL03P	004	8B
3894	SF050	005	9B
3894	SF060	006	4B
3894	SF030	007	4B
3894	SF060	008	3A
3894	*DF060*	*009*	2B
3894	DF030	010	2B
3894	SF16P	011	8B
3895	DF060	001	3A
3896	DF060	001	2B
3896	DF030	002	2B
3896	DF050	003	2B
3896	PP060	004	2B
3896	DF060	005	2B
3896	PP060	006	2B
3897	DF060	001	2A
3897	DF060	002	5B
3897	DF050	003	4B
3897	DF060	004	5B
3897	DF050	005	4B
3897	SF050	006	4B
3898	DF060	001	2A
3898	DF060	002	2A
3898	PP060	003	2A
3899	DF060	001	2B
3899	DF050	002	2B
3911	DF060	001	4B
3911	SF06P	002	4B
3911	DF05P	003	4B
3911	DF060	004	7A
3911	SF060	005	7A
3911	SF06P	006	8C
3912	SF060	001	4B
3912	SF010	002	4B
3912	AL060	003	3A
3912	SF060	004	3A
3912	SF010	005	2A
3912	SF06P	006	4B
3912	AL06P	007	4B
3912	SF050	008	4B
3912	SF060	009	4B

Geographic Area	Capability Area Type & I.D.	Number	Management Area
3912	DF050	010	4B
3912	SF06P	011	4B
3912	DF05P	012	4B
3912	DF060	013	4B
3912	SF060	014	4B
3912	SF030	015	4B
3913	SF030	001	7A
3913	SF050	002	6B
3913	PJ040	003	5B
3913	PJ040	004	5B
3913	PJ030	005	5B
3913	PJ040	006	5B
3913	PJ030	007	5B
3913	PJ040	008	5B
3913	PJ030	009	5B
3913	PJ030	010	5B
3913	WG030	011	6B
3913	WG010	012	6B
3913	WG030	013	6B
3913	DF060	014	6B
3913	DF050	015	4D
3913	SF050	016	6B
3913	SF020	017	7A
3913	SF030	018	4D
3913	SF030	019	4D
3914	PP060	001	5B
3914	PP06P	002	8B
3914	SF05P	003	8B
3914	SF050	004	8C
3914	SF030	005	9B
3914	SF020	006	9B
3914	SF060	007	6B
3914	SF050	008	6B
3914	PJ030	009	5B
3915	PJ040	001	5B
3915	PJ04P	002	8B
3915	DF06P	003	8B
3915	DF06P	004	8B
3915	PJ04P	005	8B
3915	PJ030	006	5B
3915	PJ04P	007	8B
3915	SF05P	008	8B
3915	DF06P	009	8B
3915	SF06P	010	8B
3915	AL060	011	8C
3915	PJ040	012	5B
3916	DF060	001	5B
3916	DF06P	002	8B
3916	DF06P	003	8B
3916	SF06P	004	8B
3931	DF040	001	2A
3931	SF060	002	7A
3931	DF060	003	7A
3931	DF030	004	7A
3931	DF030	005	7A
3931	DF040	006	7A
3931	DF030	007	2B
3932	SF050	001	2B
3932	SF040	002	2A
3932	SF040	003	2A
3932	AL060	004	2A
3932	SF030	005	2A
3932	SF010	006	2B
3932	SF060	007	2B
3932	DF060	008	2B
3932	DF030	009	1B-1
3932	DF050	010	2B
3932	DF030	012	2B
3932	DF030	013	2A
3932	SF060	014	2A
3932	DF060	015	2A
3933	DF050	021	3A
3933	DF05P	023	3A
3933	DF030	601	2B
3933	DF03P	602	3A
3933	SF030	603	3A
3933	AL06P	604	3A
3933	SF03P	605	3A
3933	DF01P	606	3A
3933	DF04P	607	3A
3933	SF06P	608	3A
3933	DF040	609	2B
3933	DF04P	610	3A
3933	SF04P	611	3A
3933	AL06P	612	3A
3933	SF03P	613	3A
3933	DF040	614	3A
3933	SF06P	615	3A
3933	DF04P	616	3A
3933	SF04P	617	2B
3933	SF050	618	2B
3933	SF05P	619	2B
3933	DF05P	620	7A
3933	DF06P	622	3A
3933	SF010	624	2B
3951	SF030	601	3A
3951	SF03P	602	3A
3951	AL06P	603	3A
3951	SF06P	604	3A
3951	DF06P	605	3A
3951	DF03P	606	3A
3951	DF030	607	2B
3951	DF040	608	2B
3951	SF050	609	2B
3951	SF04P	610	3A
3951	AL06P	611	3A
3971	DF030	701	10E
3971	SF060	702	10E
3971	SF010	703	10E
3971	SF030	704	10E
3971	AL060	705	10E
3971	SF030	706	10E
3971	SF010	707	10E
3971	SF060	708	10E
3972	DF010	001	5B
3972	DF010	002	5B
3972	DF010	003	5B
3972	SF030	004	4B
3972	SF060	005	4B
6301	BS220	001	6B
6301	SG210	002	6B
6301	SG210	003	6B
6301	BG210	004	6B
6311	BS220	001	6B
6311	BG230	002	6B
6311	SG210	003	6B
6511	HJ250	001	6B
6511	SD220	002	6B
6511	SL230	003	6B
6511	SL230	004	6B
6511	HJ250	005	6B
6512	SL230	001	6B
6512	HJ250	002	6B
6531	HJ250	001	6B
6531	SL230	002	6B
6532	WG210	001	6B
6532	BG220	002	6B
6551	SG210	001	6B
6551	BS220	002	6B
6552	BS220	001	6B
6571	SG210	001	6B
6571	SG21E	002	10B
6601	BS220	001	6B
6601	SG210	002	6B
6602	BS220	001	6B
6602	SG210	002	6B
6602	BS22E	003	10B
6602	SG21E	004	10B
6602	SG210	005	6B
6602	SG210	006	6B
6602	SG210	007	6B
6621	BS220	001	6B
6621	SG210	002	6B
6621	BG230	003	6B
6621	SG210	004	6B
6621	BS220	005	6B
6621	BS220	006	6B
6621	BS220	007	6B
6621	SG210	008	6B
6622	BG230	001	6B
6622	BS220	002	6B
7641	BS200	001	6B
7641	BS220	002	6B
7641	BS270	003	6B
7641	CW280	004	4B
7641	SG200	005	6B
7641	SG280	006	6B
7641	SG270	007	6B
7641	SG200	008	6B
7642	BS200	001	6B
7642	BS220	002	6B
7642	BS270	003	6B
7642	CW280	004	4B
7661	SG200	001	6B
7661	SG220	002	6B
7661	SG270	003	6B
7661	CW220	004	6B
906L	DF100	001	5B
9061	SF100	001	4D
9062	DF100	001	7A
9062	PP080	002	7A
9062	PP100	003	7A
9062	DF100	004	7D
9062	DF080	005	7D
9062	DF100	006	7D
9062	DF100	007	7D
9062	PP100	008	7D
9062	DF100	009	7A
9062	DF100	010	7A
9062	DF080	011	7A
9062	PP100	012	7A
9062	PP100	013	7A
9063	DF080	001	2B
9063	DF100	002	2B
9063	DF010	003	2B
9063	PP100	004	2B
9063	PP100	005	2B
9063	PP100	006	2B
9063	DF080	007	2B
9063	PP100	008	PVT
9063	PP080	009	4B
9063	PP070	010	2B
9064	DF080	001	4B
9064	PP080	002	4B
9065	PP08E	001	10B
9065	DF08E	002	10B
9065	DF10E	003	10B
9065	PP07E	004	10B
9065	PP100	005	7A
9066	DF10E	001	10B
9066	DF08E	002	10B
9066	DF10E	003	10B
9066	PP07E	004	10B
9066	PP100	005	2B
9066	PP070	006	2B
9066	PP070	007	2B
9066	PP080	008	7A
9066	DF080	009	7A
9066	DF100	010	2B
9066	DF080	011	2B
9067	PP100	001	2B
9068	PP100	001	2B
9068	DF100	002	2B
9068	DF080	003	2B
9068	PP080	004	2B
9068	DF080	005	2B
9068	PP100	006	2B
9069	DF08E	001	10B
9151	DF100	001	7D
9152	DF100	001	2B
9153	DF080	001	4B
9153	PP080	002	4B
9153	DF100	003	2A
9153	DF100	004	7D
9154	PP100	001	4B
9154	PP080	002	4B
9154	DF100	003	2A
9154	DF080	004	4B
9154	DF100	005	2A
9154	DF080	006	2B
9154	DF100	007	2B
9171	DF080	001	5B
9171	DF080	002	2A
9171	DF100	003	7D
9171	DF080	009	5B
9171	DF080	704	10E
9171	DF080	705	10E
9171	DF100	706	10E
9171	DF080	707	10E
9171	DF080	708	10E
9171	DF080	710	5B
9172	PP100	001	2B
9172	PP080	002	5B
9172	PP080	003	2B
9172	DF08A	004	4B
9172	PP080	005	2A

Geographic Area	Capability Area Type & I.D.	Number	Management Area
9172	PP080	006	2A
9172	PP100	007	7D
9172	PP100	008	2B
9172	DF070	009	2B
9172	DF100	010	2B
9172	DF080	011	2A
9173	PP100	001	5B
9173	DF080	002	5B
9173	DF080	003	2A
9173	DF100	004	2B
9173	DF100	005	2B
9173	DF080	007	2B
9173	DF100	008	2A
9173	DF08A	009	4B
9173	PP10A	010	2B
9173	DF10A	011	2A
919L	PP100	001	PVT
9190	DF080	001	5B
9190	DF100	002	2A
9190	DF070	003	2B
9190	SF080	004	2B
9190	SF100	005	2B
9190	DF080	006	2B
9191	DF100	002	2B
9191	PP100	003	2B
9191	DF100	701	2B
9192	SF190	001	10E
9192	SF190	003	1B
9192	AL190	004	10E
9192	SF100	005	4D
9192	SF100	009	10E
9192	DF100	010	10E
9192	AL190	702	10E
9192	SF100	706	10E
9192	DF100	707	10E
9192	SF100	708	10E
9192	DF100	711	10E
9193	SF100	002	10E
9193	DF080	007	10E
9193	DF100	009	10E
9193	AL190	701	10E
9193	SF100	703	10E
9193	SF100	704	10E
9193	DF100	705	10E
9193	DF100	708	10E
9193	DF100	710	10E
9193	DF080	906	2B
9194	PJ100	001	2B
9194	PP080	002	2B
9194	DF100	004	2B
9194	DF100	006	2B
9194	DF080	007	2B
9194	DF080	008	2B
9194	DF100	703	2B
9195	DF080	001	2A
9195	DF100	013	9B
9195	DF10E	014	2A
9195	DF080	015	2A
9195	DF080	702	10E
9195	SF080	703	10E
9195	DF080	704	10E
9195	DF100	705	10E
9195	SF100	706	10E
9195	SF190	707	10E
9195	SF190	708	10E
9195	AL190	709	10E
9195	DF100	710	10E
9195	SF080	711	10E
9195	DF080	712	10E
9196	DF100	701	10E
9196	SF190	702	10E
9197	SF100	001	2A
9197	SF190	002	2A
9197	SF080	003	2A
9197	SF190	704	10E
9198	DF080	001	2B
9198	DF080	002	2B
9198	DF080	003	2A
9198	SF100	004	2A
9198	DF080	006	2B
9198	DF080	705	2A
9199	DF080	001	2A
9199	SF100	002	2B
9211	SF190	001	5B
9211	SF190	002	5B
9211	SF190	003	4D
9211	SF180	004	5B
9211	AL190	005	5B
9211	SF190	006	5B
9211	SF190	007	5B
9211	SF190	008	2B
9211	SF190	009	4D
9212	DF080	001	5B
9212	SF080	002	5B
9212	SF190	003	5B
9212	SF100	004	2A
9212	SF190	005	2A
9212	AL190	007	5B
9212	AL190	009	5B
9212	SF180	010	5B
9212	AL190	012	5B
9212	SF180	706	10E
9212	AL190	708	10E
9213	DF080	001	2A
9213	DF100	002	2A
9213	SF080	003	2A
9213	SF190	004	4D
9213	SF100	005	2A
9213	SF100	006	4D
9213	SF190	007	2A
9214	AL190	002	5B
9214	AL190	006	10E
9214	AL190	703	10E
9214	AL190	705	10E

APPENDIX F

APPENDIX F

MINERAL STIPULATIONS

Form 3109–3
(June 1971)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

STIPULATION FOR LANDS UNDER JURISDICTION OF DEPARTMENT OF AGRICULTURE*

The lands embraced in this lease or permit being under the jurisdiction of the Secretary of Agriculture, the lessee or permittee hereby agrees:

(1) To conduct all operations authorized by this lease or permit with due regard for good land management, not to cut or destroy timber without first obtaining permission from the authorized representative of the Secretary of Agriculture, and to pay for all such timber cut or destroyed at the rates prescribed by such representative, to avoid unnecessary damage to improvements, timber, crops, or other cover; unless otherwise authorized by the Secretary of Agriculture, not to drill any well, carry on operations, make excavations, construct tunnels, drill, or otherwise disturb the surface of the lands within 200 feet of any building standing on the lands and whenever required, in writing, by the authorized representative of the Secretary of Agriculture to fence or fill all sump holes, ditches, and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the lands to their former condition, including the removal of structures as and if required, and when required by such representative to bury all pipelines below plow depth.

(2) To do all in his power to prevent and suppress forest, brush, or grass fires on the lands and in their vicinity, and to require his employees, contractors, subcontractors, and employees of contractors or subcontractors to do likewise. Unless prevented by circumstances over which he has no control, the lessee or permittee shall place his employees, contractors, subcontractors, and employees of contractors and subcontractors employed on the lands at the disposal of any authorized officer of the Department of Agriculture for the purpose of fighting forest, brush, or grass fires on or originating on the lands or on adjacent areas or caused by the negligence of the lessee or permittee or his employees, contractors, subcontractors and employees of contractors and subcontractors, with the understanding that payment for such services shall be made at rates to be determined by the authorized representative of the Secretary of Agriculture, which rates shall not be less than the current rates of pay prevailing in the vicinity for services of a similar character. *Provided,* that if the lessee or permittee, his employees, contractors, subcontractors, or employees of contractors or subcontractors, caused or could have prevented the origin or spread of said fire or fires, no payment shall be made for services so rendered

During periods of serious fire danger to forest, brush, or grass, as may be specified by the authorized representative of the Secretary of Agriculture, the lessee or permittee shall prohibit smoking and the building of camp and lunch fires by his employees, contractors, subcontractors, and employees of contractors or subcontractors within the area involved except at established camps, and shall enforce this prohibition by all means within his power: *Provided,* that the authorized representative of the Secretary of Agriculture may designate safe places where, after all inflammable material has been cleared away, campfires may be built for the purpose of heating lunches and where, at the option of the lessee or permittee, smoking may be permitted

The lessee or permittee shall not burn rubbish, trash, or other inflammable materials *except* with the consent of the authorized representative of the Secretary of Agriculture and shall not use explosives in such a manner as to scatter inflammable materials on the surface of the lands during the forest, brush, or grass fire season, *except* as authorized to do so or on areas approved by such representative.

The lessee or permittee shall build or construct such fire lines or do such clearing on the lands as the authorized representative of the Secretary of Agriculture decides is essential for forest, brush, and grass fire prevention which is or may be necessitated by the

* This form of stipulation may be used in connection with leases and permits issued under the Acts of February 25, 1920, as amended (30 U S C 181 *et seq*), August 7, 1947 (30 U S C 351 *et seq*), February 7, 1927, as amended (30 U S C 281 *et seq.*), April 17, 1926, as amended (30 U S C 271 *et seq*), June 28, 1944 (58 Stat 483–485), September 1, 1949 (30 U S C 192c), June 30, 1950 (16 U S C 508b), or under the authority of any of the Acts cited in Section 402 of the President's Reorganization Plan No 3 of 1946 (5 U S C 133y–16, Note).

exercise of the privileges authorized by this lease or permit, and shall maintain such fire tools at his headquarters or at the appropriate location on the lands as are deemed necessary by such representative.

(3) In the location, design, construction, and maintenance of all authorized works, buildings, plants, waterways, roads, telegraph or telephone lines, pipelines, reservoirs, tanks, pumping stations, or other structures or clearance, the lessee or permittee shall do all things reasonably necessary to prevent or reduce to the fullest extent scarring and erosion of the lands, pollution of the water resources and any damage to the watershed. Where construction, operation, or maintenance of any of the facilities on or connected with this lease or permit causes damage to the watershed or pollution of the water resources, the lessee or permittee agrees to repair such damage and to take such corrective measures to prevent further pollution or damage to the watershed as are deemed necessary by the authorized representative of the Secretary of Agriculture.

(4) If in the opinion of the authorized representative of the Secretary of Agriculture, the lands are valuable for watershed protection, the lessee or permittee shall provide for control of surface runoff and return the affected area to as productive condition as practicable.

(5) To pay the lessor or permitter or his tenant or the surface owner or his tenant, as the case may be, for any and all damage to or destruction of property caused by the lessee's or permittee's operations hereunder, to save and hold the lessor or permitter or the surface owner or their tenants harmless from all damage or claims for damage to persons or property resulting from the lessee's or permittee's operations under this lease or permit.

(6) To recognize existing uses and commitments, in the form of Department of Agriculture grazing, timber cutting, and special use permits, water developments, ditch, road, trail, pipeline, telephone line, and fence rights-of-way and other similar improvements, and to conduct his operations so as to interfere as little as possible with the rights and privileges granted by these permits or with other existing uses.

(7) To install and maintain cattle guards to prevent the passage of livestock in any openings made in fences by the lessee or permittee or his contractors to provide access to the lands covered by this lease or permit for automotive and other equipment.

(8) If lessee or permittee shall construct any camp on the lands, such camp shall be located at a place approved by the authorized representative of the Secretary of Agriculture, and such representative shall have authority to require that such camp be kept in a neat and sanitary condition.

(9) To comply with all federally-approved rules and regulations of the Secretary of Health, Education, and Welfare governing the emission of pollutants into the air from activities which are embraced in this lease or permit.

(10) To comply with all the rules and regulations of the Secretary of Agriculture governing the national forests or other lands under his jurisdiction which are embraced in this lease or permit.

(11) Unless otherwise authorized, prior to the beginning of operations to appoint and maintain at all times during the term of this lease or permit a local agent upon whom may be served written orders or notices respecting matters contained in this stipulation, and to inform the authorized representative of the Secretary of Agriculture, in writing, of the name and address of such agent. If a substitute agent is appointed, the lessee or permittee shall immediately so inform the said representative.

(12) To address all matters relating to this stipulation

to Forest Supervisor
Pike & San Isabel National Forests
at 1920 Valley Drive
Pueblo, CO 81008

who is the authorized representative of the Secretary of Agriculture, or to such other representative as may from time to time, be designated, provided that such designation shall be in writing and be delivered to the lessee or permittee or his agent.

(Signature of Lessee)

GPO 850-292

FOREST SERVICE (R-2) SUPPLEMENT A
TO FORM 3109-3

SERIAL NO._____

FURTHER PLANNING AREA STIPULATION

The following described lands embraced in this lease/permit/license were identified in the Roadless Area Review and Evaluation (RARE II) decision document as requiring further planning.

Future planning may identify all or part of these lands as suitable for wilderness, and the lands so identified may ultimately be designated as Wilderness. Information made available to the Forest Service regarding discoveries of mineral deposits on these lands will be considered in the planning process and may be key factors in the land allocation.

This clause shall become inoperative in the event this area is determined as not suitable for wilderness.

Any terms of this lease/permit/license to the contrary notwithstanding, the following terms shall apply to the above described lands:

1. Only exploration activities for the purposes of discovering and disclosing the extent of mineral deposits is allowed, until development and production operations are specifically concurred in by the Forest Service based on a land management plan and/or a specific environmental analysis of an operating plan.

2. Exploration plans must be specifically approved by the Bureau of Land Management and concurred in by the Forest Service. Plans for geophysical exploration must be approved by the Forest Service. The Forest Service will agree to reasonable access for conducting necessary exploration operations.

3. Any lands covered by this lease/permit/license which Congress designates as Wilderness shall become subject to the provisions of the applicable Wilderness legislation, and the Secretary of Agriculture's regulations and Forest Service policies pertaining thereto

4. The lessee/permittee/licensee will be responsible as he deems necessary to protect his interest, for initiating requests to the Department of the Interior for suspension of lease/permit/license terms, rental, or minimum royalties. The Forest Service does not intend that the inclusion of this stipulation be construed as a basis to deny a request for suspension

5. Until these lands are allocated to non-wilderness purposes, by a land management plan or specific environmental analysis and decision, mineral-related operations are subject to the following terms:

   (a) Construction of access ways and operation sites will not be permitted in areas of extremely high environmental sensitivity where such construction would cause serious and irreparable environmental damage.

   (b) Access way construction will be permitted only where existing access ways are inadequate or other methods of access are impractical.

   (c) Access ways will be built to a standard no higher than required for passage of equipment and support personnel, and to protect surface resources.

   (d) The access ways and other areas of operation will be reclaimed, as soon as they have served their purpose, to a condition as near as practical to the surface condition existing prior to the authorized use of the lands.

This stipulation is hereby accepted.

_____ Date

_____ Signature

(2/84)

FOREST SERVICE (R-2) SUPPLEMENT B
TO FORM 3109-3

SERIAL NO._____

CLASSIFIED AREA STIPULATION
(36 CFR 251.23 and 294)

The use of the lands within the external boundaries of the _____ Classified Area as described below, for the purpose of this license/permit/lease will be restricted to the following unless otherwise specifically agreed to by the Forest Service in the Operation Plan:

(a) To conduct prospecting and exploratory activities upon said lands for the purpose of locating and determining the existence of possible mineral resources beneath said lands by the use of such instruments and non-motorized equipment as may be carried by hand or on horseback. No explosives shall be used nor shall any wheeled, mechanized or motorized vehicles or equipment be used or transported upon the surface of said lands for such purposes.

(b) Operations shall be authorized to drill for, produce, and remove minerals from said lands by methods which will avoid invasion or disturbance of the surface.

(c) This stipulation is in effect for the following described lands:

_____
Licensee/Permittee/Lessee

Note: The applicant is encouraged to contact the District Ranger for further information regarding the restrictive nature of this stipulation.

(2/84)

FOREST SERVICE (R-2) SUPPLEMENT C
TO FORM 3109-3

SERIAL NO. _____

LIMITED SURFACE USE

The license/permittee/lessee is hereby given notice that there are within the license/permit/lease area tracts that contain special values or surface constraints, or which are needed for special purposes, and require special attention to prevent irreversible or irretrievable damages to surface resources, including wildlife. Surface use or occupancy upon such tracts will be authorized only upon satisfaction of two (2) conditions: (1) such use or occupancy must be demonstrated to be essential to operations; and (2) operating plans must provide for such measures as are satisfactory to the Forest Service for protection of the described special values and existing or planned special purpose uses which may conflict with the uses otherwise authorized by this license/permit/lease. After the Forest Service has been advised of proposed license/permit/lease operations, and on request of the operator, the Forest Service will furnish further data on the tracts containing special values, surface constraints or special purpose uses, which now include but are not limited to:

Description:

Reason for Restriction and duration (if less than full time, designate months--should there be a discovery of a producible resource, operating plan requirements will be adjusted accordingly):

_____
Licensee/Permittee/Lessee

NOTE: The applicant is encouraged to contact the District Ranger for further information regarding the restrictive nature of this stipulation.

FOREST SERVICE (R-2) SUPPLEMENT D
TO FORM 3109-3

SERIAL NO _____

SURFACE DISTURBANCE STIPULATION

1. Notwithstanding any provision of this license/permit/lease to the contrary, any drilling, construction or other operation on the lands covered by this license/permit/lease that will disturb the surface thereof or otherwise affect the environment (hereinafter called "surface disturbing operation") conducted by licensee/permittee/lessee shall be subject, as set forth in this stipulation, to the prior approval of such operation by the Bureau of Land Management (BLM) in consultation with the Forest Service, and to such reasonable conditions not inconsistent with the purposes for which this license/permit/lease is issued, as the authorized officer may require to protect the surface of these lands and the environment

2 Prior to entry upon the land, or the disturbance of the surface thereof, for drilling or other purposes, the licensee/permittee/lessee shall submit for approval the appropriate number of copies of a map and explanation of the nature of the anticipated activity and surface disturbance to the Bureau of Land Management and the Forest Service Officer, as shown in Item 12 of the BLM Form 3109-3 The plan of operation must assure adequate protection of drainages, water bodies, springs, or fish and wildlife habitat, steep slopes or fragile soil

3. An environmental analysis will be made by the Bureau of Land Management, in consultation with the Forest Service, for the purpose of insuring proper protection of the surface, the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands

   Upon completion of said environmental analysis, the authorized officer of the Bureau of Land Management shall notify the licensee/permittee/lessee of the conditions, if any, to which the proposed surface disturbing operations will be subject.

   Said conditions may relate to any of the following

   (a) The location of drilling or other exploratory or developmental operations or the manner in which they are to be conducted.

   (b) The types of vehicles that may be used and the areas in which they may be used.

   (c) The manner or location in which improvements such as roads, buildings, pipelines, or other improvements are to be constructed

4. The licensee/permittee/lessee agrees that during periods of adverse conditions due to climatic factors such as thawing, heavy rains, or flooding, all activities creating irreparable or extensive damage, as determined by the Forest Service, will be suspended or the plan of operation modified and agreed upon

5. PROTECTION OF CULTURAL AND PALEONTOLOGICAL RESOURCES

   (a) The Forest Service is responsible for assuring that the area to be disturbed on this license/permit/lease is inventoried to determine the presence of cultural resources and to specify those cultural resources requiring protection and/or mitigation measures to be undertaken by the operator.

   Unless notified to the contrary by the Forest Service, the operator may, at his discretion and cost, conduct the inventory on the lands to be disturbed This intensive inventory must be done by, or under the supervision of, a qualified archeologist approved by the Forest Service. Upon review of the inventory report, the Forest Service will specify those cultural resources requiring protection and/or mitigation measures to be undertaken by the operator. All costs of protection and salvage of cultural resource values will be borne by the operator and all data and materials salvaged will remain under the jurisdiction of the U S. Government as appropriate

   (b) The operator shall bring to the attention of the Forest Service and the Bureau of Land Management, significant paleontological values encountered in areas to be disturbed, for evaluation and for instructions as to the appropriate action to be followed by the operator

   (c) The operator shall immediately cease operations in areas in which any antiquities or other objects of historic or scientific interest are discovered and bring the discovery to the attention of the Forest Service and the authorized officer of the Bureau of Land Management. Any such discoveries shall be left intact until the operator is permitted to proceed by the authorized officer of the Bureau of Land Management.

6. PPOTECTION OF ENDANGERED OR THREATENED SPECIES

   The Forest Service is responsible for assuring that the area to be disturbed is examined, prior to undertaking any ground disturbing activities on lands covered by this license/permit/lease, to determine effects upon any plant or animal species listed or proposed for listing as endangered or threatened, or their habitats The findings of this examination may result in some restrictions to the operator's plans or even disallow any use and occupancy that would detrimentally affect any of the endangered or threatened plant or animal species.

   The operator may, at his discretion and cost, conduct the examination on the lands to be disturbed This examination must be done by or under the supervision of a qualified resource specialist approved by the Forest Service. An acceptable report must be provided to the Forest Service identifying the anticipated effects of the proposed action on endangered species or their habitat

_____
Licensee/Permittee/Lessee
(2/84)

FOREST SERVICE (R-2) SUPPLEMENT E
TO FORM 3109-3

WILD AND SCENIC RIVERS SYSTEM STIPULATIONS

This stipulation applies to National Forest System lands adjacent to the _____River, under study for possible inclusion in the National Wild and Scenic Rivers System (82 Stat. 906, as amended).

1. The licensee/permittee/lessee may not use, occupy, or disturb any surface portion of the license/permit/lease application area described in this stipulation without prior specific authorization of the Forest Service while the Congress is considering inclusion of the River into the National Wild and Scenic River System.

   a. If Congress adds the River to the National Wild and Scenic River System, the Forest Service will prepare a management plan which will specify the particular controls on the lands described below.

   b. If by the date prescribed by Section 7b of the Wild and Scenic River Act (82 Stat. 906, as amended) or possible amendments, the Congress has not added the River to the National Wild and Scenic River System, the area will be used according to a National Forest Land Resources Management Plan which may specify particular controls or special requirements for mineral development on the license/permit/lease area.

2. This stipulation is in effect for the following described lands:

_____
Licensee/Permitee/Lessee

Note: The applicant should know that there is at this time no assurance that use, occupancy, or disturbance of the surface of the above described land can ever be permitted.

(2/84)

FOREST SERVICE (R2) SUPPLEMENT F
TO FORM 3109-3

SERIAL NO. _____

SURFACE USE STIPULATION

Surface use or occupancy that would cause significant surface disturbance is not authorized for the lands described below. This does not apply to casual or other uses which do not significantly disturb surface resources. The operator must have advance approval of the authorized officers of the Bureau of Land Management (BLM) and the Forest Service for any surface uses related to lease operations.

Reasons for restriction:

_____
Lessee/Licensee/Permittee

Note: The applicant is encouraged to contact the District Ranger for further information regarding the restrictive nature of this stipulation.

(2/84)

FOREST SERVICE (R-2) SUPPLEMENT G
TO FORM 3109-3

SERIAL NO. _____

ACTIVITY COORDINATION STIPULATION

This lease includes lands within _____

_____ which has resource values sensitive to high levels of activity. In order to minimize impacts to these resources, special conditions, such as unitization prior to approval of operations and/or limitations to spread surface disturbance activities over time and space may be required prior to approval and commencement of any operations on the lease.

This stipulation is in effect for the following described lands:

Reason for Restriction:

_____
Licensee/Permittee/Lessee

Note: The applicant is encouraged to contact the Forest Supervisor for further information regarding the restrictive nature of this stipulation.

(2/84)

FOREST SERVICE (R-2) SUPPLEMENT H
TO FORM 3109-3

SERIAL NO. _____

CONDITIONAL NO SURFACE DISTURBANCE STIPULATION

The prospective licensee/permittee/lessee is given notice that parts of the lands described are affected by the following conditions:

	Check as Applies
- Slopes steeper than _____ percent. (40 percent, classified lands; 60 percent unclassified lands)	_____
- High erosion hazard.	_____
- High hazard for mass slope failure.	_____
- Threatened or endangered wildlife or plant species, as follows:	
-- Activities will not be permitted that will jeopardize the survival or recovery of Federally listed T&E species (_____ Name of Species)	_____
-- Activities may or may not be permitted to intrude upon identified critical or essential habitat of Federally listed species, and will not be permitted to intrude upon the animal or plant itself. (_____ Name of Species)	_____
-- Activities may or may not be permitted to intrude upon identified habitat of an animal or plant listed by the State as threatened or endangered or by the Regional Forester as needing special management to prevent the need for Federal listing of the species as threatened or endangered; activities will not be permitted to intrude upon the animal or plant itself. (_____ Name of Species)	_____
- Low visual absorption capacity requiring special measures for mitigation.	_____

Should the prospective licensee/permittee/lessee accept this contract, this document is his acknowledgement that surface disturbance, including occupancy and use of the surface of those parts of the lands affected by the above-described conditions, will be authorized only if an operating plan can be devised that will provide for the surface resource protection required due to the above-described conditions. This stipulation is in effect for the following described lands:

_____
Signature
(Licensee/Permittee/Lessee)

NOTE: The applicant is encouraged to contact the Forest Supervisor for further information regarding the restrictive nature of this stipulation before acceptance of this contract and the operator is encouraged to make the same contact well in advance of proposed operations.

(2/84)

APPENDIX G

APPENDIX G

FIRE MANAGEMENT ANALYSIS

This is a summary of the results from the updating of the Fire Management Analysis and planning for the Pike and San Isabel National Forests. The results show very little change from the analysis that was done during the first half of Fiscal Year 1980.

This analysis used Fire Management planning zones. The original analysis was by fuel types and slopes. This plan used the Forest fire weather stations with similar fuel types for historical fire and weather data and these were called Fire Management Analysis Zones 1 through 7.

Fire Management Analysis Level I is an analysis of the management situation. The analysis uses information describing the current situation and inventories; current and historical fire and weather information; and program costs. Fire Management Analysis Level II is an evaluation of Fire Program options and program mixes. This process was used to find the most cost-efficient program. The most cost-efficient program is used in the implementation of the Fire Management Planning Level III. Fire Management Planning Level IV is the operational project evaluation. The analysis and planning process is found in the Fire Management Analysis and Planning Handbook (FSH 5109.19).

The Forest was divided into two major fuel models, G & H for the high country and C, K, U for the remainder of the Forest. There are seven Fire Management Analysis zones, 2 in the G-H fuel model and 5 in the C-K-U fuel models. Fuel models G & H represent dense conifer stands and short needled conifers respectively. Fuel model C typifies open pine stands. Fuel model K is used to represent light thinnings and partial cuts in conifer stands. Fuel model U represents closed stands of western long-needled pines. (More complete detail on fuel models is found in USDA Report INT-39.) The Grasslands were not used in this analysis. "C" is the primary fuel model for the lower elevations and "G" is the primary fuel model for the higher elevations.

Attached are forms showing the most cost-effective option of the five programs, alternatives and mixes used at the Forest level. The non-dollar values shown on Table II-A determine the relative impacts of fire on the environmental values and the social, public and technical values that were considered for this plan.

The Level II part of this analysis required a projection of the number and types of personnel, engines (pumpers), air tankers, helicopters and heavy equipment involved in the suppression of these modeled fires. The travel time, amount of work produced, and the fire intensity level at which these resources were dispatched was an essential part of the analysis. Detailed data and comparisons are filed under 5190 at the Pike and San Isabel Forest Supervisor's Office.

The following table shows the Fire Management Zone name, number, fuel model, weather station name and number, and average slope.

Name	Number	Fuel Model	Weather Station and Number		Average Slope
Bailey	PSI01	C-K	Buffalo Cr.	053101	20 to 30 (2)
Monument	PSI02	C-U	A.F.A.	053602	10 to 20 (1)
Tarryall	PSI03	C-K	Lake George	053002	10 to 20 (1)
Buffalo Peaks	PSI04	G-H	Fairplay	053003	20 to 30 (2)
Aspen Ridge	PSI05	C-U	Red Deer	052902	10 to 20 (1)
Hardscrabble	PSI06	C-K	Buffalo Cr.	053101	20 to 30 (2)
Greenhorn	PSI07	G-H	Lake Isabel	054002	20 to 30 (2)

Volunteer Fire Department personnel were used more often as appropriated fire funding was decreased. The Forest has depended largely on seasonal personnel that work in other functions for initial attack as shown in option 001. Ninety percent of the initial attack ground crews were these seasonal employees. The engines were manned by trained seasonal personnel who generally had one or more years experience in fire fighting as a Forest worker on a District. Reduction in seasonal forces hired primarily for non-fire work will have definite effect on initial attack crews.

Wildfires are spread throughout the Forest with more than 60 percent of them occurring in FMAZ 1, 3, and 6. Zone 5 has the least fires with approximately 3 percent. We are normally faced with three fire seasons. First one starting about the first of May to the fifth of June, second season June 25 to July 12, and the third season from approximately August 25 to October 31.

Option 001	Is the cost efficient level identified in 1980 (Base Level)
Option 002	Is minus 20 percent of Base Level
Option 003	Is plus 20 percent of Base Level
Option 004	Is minus 40 percent of Base Level
Option 005	Is plus 40 percent of Base Level

Net value change at the different options is as follows:

	Value Change + or -	
001	0%	Base
002	-109%	-20%
003	+48%	+20%
004	-258%	-40%
005	+80%	+40%

TABLE I-A HISTORICAL FIRE PROGRAM DATA

YEAR	COSTS			TOTAL AREA BURNED	TOTAL NUMBER OF FIRES	COMMENTS, RESOURCES
	TOTAL FFP BUDGET (1)	SUPPRESSION (2)	TOTAL FIRE PROG. (1+2)			
	M$	M$	M$	Acres		
1971	135	90	225	640	140	Number of acres and number of fires have not changed significantly during the past 20 years. Suppression costs have risen an estimated 5% per year since 1971 through 1980.
1980	268	168	436	632	137	

TABLE 1-B PROJECTED FIRE PROGRAM - PREFERRED ALTERNATIVE (LEVEL I)

FOREST PLAN TIME PERIOD	COSTS			EXPECTED AREA BURNED	COMMENTS, EXPECTED CHANGE IN RESOURCES, ETC.
	TOTAL FFP BUDGET (1)	SUPPRESSION (2)	TOTAL FIRE PROG. (1+2)		
	M$	M$	M$	Acres	
1985	495	198	693	429	During this period of 65 years, suppression type resources will be modified for quicker initial attack time which should result in approximately 20% reduction in average acres burned. Costs have been increased by 1% per year. These are "real" cost increases and do not reflect inflation.
2050	816	327	1143	400	

TABLE II-A SUMMARY OF RESULTS OF FMA LEVEL II OPTIONS

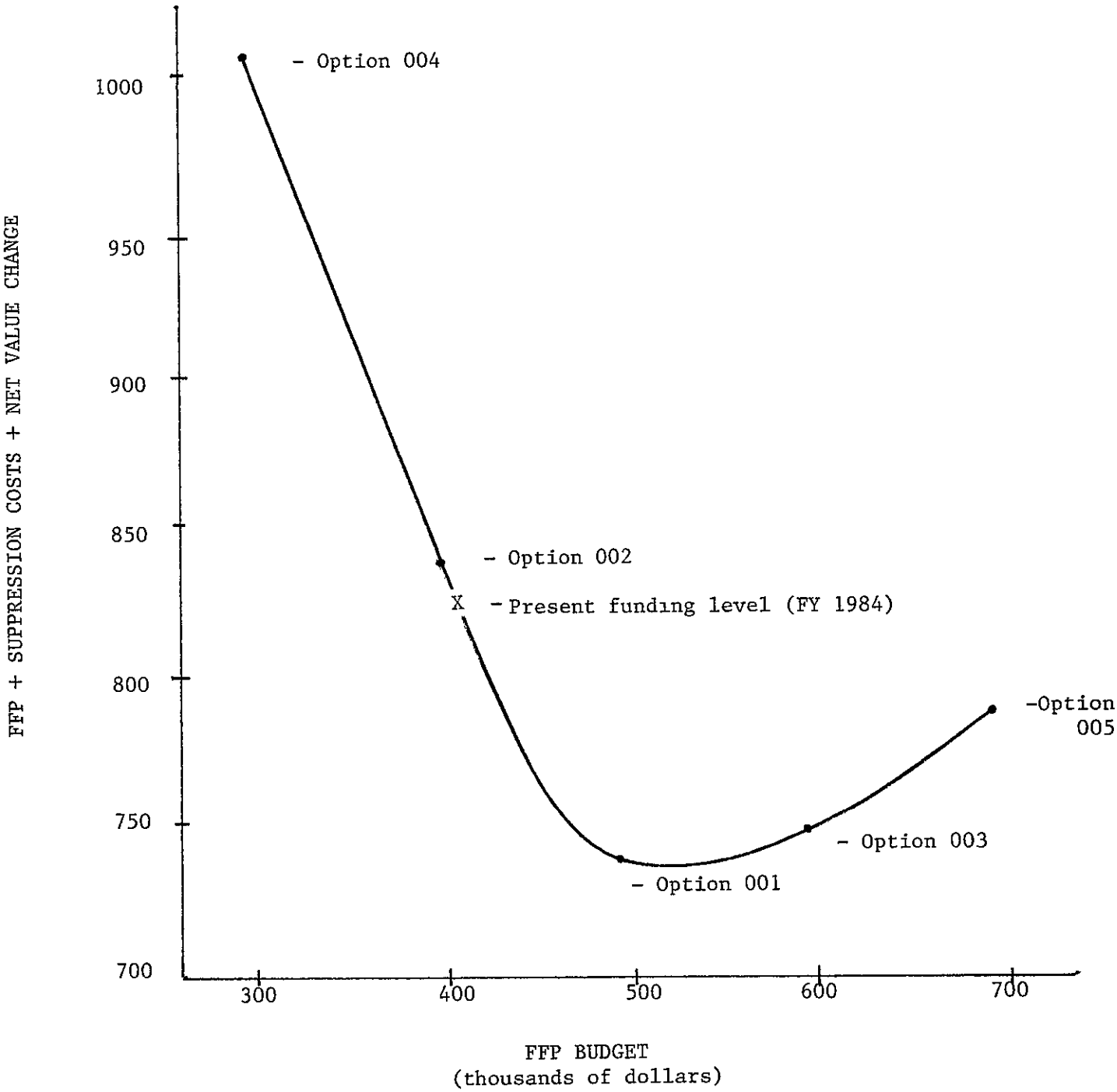
OPTION	COSTS		TOTAL NET VALUE CHANGE (3)	COSTS & NVC (1+2+3)	EXPECTED ACRES BURNED	TOTAL NON DOLLAR VALUE	COMMENTS, RESOURCES ETC.
	TOTAL FFP BUDGET (1)	SUPPRESSION (2)					
	M$	M$	M$	M$	ACRES	+ OR -	
001	495	198	43	736	429	-66	Option 001 is the cost efficient level
002	396	353	89	838	909	-103	Option 002 is the -20% of this base.
003	594	130	22	748	236	-19	Option 003 is the +20% of this base.
004	297	602	153	1052	1566	-137	
005	693	74	9	776	108	+10	

TABLE II-B PROJECTED FIRE PROGRAM-PREFERRED ALTERNATIVE AND OPTION (LEVEL II)

FOREST PLAN TIME PERIOD	COSTS		TOTAL NET VALUE CHANGE (3)	COSTS & NVC (1+2+3)	EXPECTED ACRES BURNED	COMMENTS, CHANGES IN RESOURCES, RESOURCE MIXES OVER TIME
	TOTAL FFP BUDGET (1)	SUPPRESSION (2)				
	M$	M$	M$	M$	ACRES	
1985	495	198	43	736	429	Costs for FFP, FFF & NVC have been increased 1% per year. Acreage reflects a prevention program for education of the general public and for faster and improved techniques of fire suppression for the projected time period.
2050	816	327	71	1214	400	

TABLE III

FIRE MANAGEMENT EFFECTIVENESS



APPENDIX H

APPENDIX H

MINERAL POTENTIAL REPORT

FOR

PIKE AND SAN ISABEL NATIONAL FORESTS

AND

COMANCHE AND CIMARRON NATIONAL GRASSLANDS

by

JOHN S. DERSCH, Geologist

USDA, Forest Service
Watershed, Soils, and Minerals Area Management
Lakewood, Colorado

April 6, 1981
(Revised May 15, 1984)

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ANALYSIS OF THE PLANNING REQUIREMENTS

A. INTRODUCTION

The National Forest Management Act of 1976 requires that Land Management Plans be created for National Forest System lands. The regulations (36 CFR 219.22) state:

"Mineral exploration and development in the planning area shall be considered in the management of renewable resources. The following shall be recognized to the extent practical in the Forest planning:

(a) Active mines within the area of land covered by the forest plan;
(b) Outstanding or reserved mineral rights;
(c) The probable occurrence of various minerals, including locatable, leasable, and common variety;
(d) The potential for future mineral development and potential need for withdrawal of areas from development;
(e) Access requirements for mineral exploration and development; and
(f) The probable effect of renewable resource prescriptions and management direction on mineral resources and activities, including exploration and development."

The mineral resources assessment provides the information to document and display the foregoing in the Forest Plan, and relate it to management practices, standards, prescriptions, and alternatives.

B. ANALYSIS

A mineral potential evaluation was conducted to determine the possible existence of locatable and leasable mineral deposits on National Forest System lands. Mineral potentials were determined for metallic and non-metallic minerals and energy fuels. A set of general criteria was established which included known favorable geology and structure, known mineral occurrences and reserves (if data available), and field activity related to mineral exploration, development, and production. The "potential levels," determined as High, Medium, Low, No, and Unknown are based on today's knowledge and prices and may change at any time, depending on the mineral economy, technological advances, or further exploration. High mineral potential includes favorable geology and structure, known economically valuable mineral occurrences and reserves (if data available), and field activity. Medium mineral potential includes favorable geology and structure, known mineral occurrences with insufficient evidence of present economic value, or sub-economic deposits, and occasional activity. Low potential includes geology considered unfavorable at this time, no known mineral occurrences, explored or prospected sites determined non-economic, and little or no present activity, but does not infer the lack of mineral deposits. The No potential level indicates that the nature of the geologic environment is not favorable for the leasable commodity type indicated, no

known resources and sporadic field work. The Unknown potential level includes all areas where the geology masks the terrain limiting the ability to readily obtain information but the geologic environment could be favorable, no known resources or basic exploratory work (see Page 5 for mineral potential level matrix.)

The following eight Mineral Element Levels "rate" the potential occurrence of mineral-related activities during the life of the management plan:

1. Locatable/leasable minerals - Producing sites/known reserves
2. Locatable minerals - High/medium potential
3. Leasable minerals - High/medium potential
4. Locatable/leasable minerals - Low potential
5. Leasable Minerals - No potential
6. Leasable Minerals - Unknown potential
7. Reservations and Outstanding Rights - All levels of potential; Mineral Withdrawals
8. Salable minerals - Known areas

(See Pages 6 to 9 for a detailed description of the mineral element levels.)

The areas of known reserves and producing sites must be administered knowing that surface resource management programs will require close coordination with the mineral activity. Forest Administration will involve access, related special use permits, reclamation, and the like.

In High and Medium potential areas, any stage of exploration, production, or development can be expected to occur during the first ten years of the plan's application.

In Low potential areas, the probabilities are that any mineral activities during the first ten years of the plan will be limited to prospecting and exploration. Even if a valuable deposit is discovered, particularly a major one, it is unlikely that the necessary permits and approvals can be acquired to put it into production within the ten year period.

In the No potential areas, activities generally will be very limited for at least the first ten years of the plan.

Activities within the Unknown potential areas will probably occur during the lifetime of the plan because of the unknown aspect. Should a valuable deposit be discovered, the time frame required for permits and approvals, and to implement production plans would require a minimum of ten years. Thus activities during the first ten year period will be very limited.

Advances in exploration or production technology may result in greater activity levels in all areas, regardless of the current potential rating.

The Forest resource manager considers what types of mineral activity are likely to occur and how this activity will affect surface resource programs. The search for minerals can be expected to start from an area with

a "history of production" or "similar geologic environment" (relative to known deposits) and radiate from that point. The sequence of activities is usually prospecting, exploration, development, and production. Exploration methods include, but are not limited to, photogeology, geophysical and geochemical methods, surface drilling, and underground work. Those activities involving significant surface disturbance are normally covered by an operating plan or prospecting permit. Development and production may follow if a valuable deposit of minerals or fossil fuels is found. The methods of development for a minable mineral or fossil fuel deposit cannot be determined until knowledge of the ore body configuration, the grade and tonnage of ore, the depth of the mineralization, and other factors have been gained. Current technology requires that oil, gas, and geothermal resources be developed by wells with associated surface facilities. Approvals of operating plans for development and production are preceded by environmental analyses or, if the proposed activities are considered to be *major Federal actions affecting the environment, environmental impact* statements.

Most patented mining claims will be found in levels classified 1, 2, and 3, above. Except in Wildernesses, patentees acquire both the surface and the minerals estates. Such properties are private land in every sense of the term. The Forest Service has no direct authority over operations on such lands.

The mineral potential maps were developed by gathering data from individuals and references, plotting on overlays, and evaluating the data. Mineral expertise was sought from Federal, State, and private sectors. Some individuals outside the Forest Service who provided information were:

Ted Armbrustmacher, U.S. Geological Survey
Dave Baskin, U.S. Bureau of Mines
Max Bergendahl, AMAX, Inc.
Larry Brady, Kansas Geological Survey
Karin Budding, U.S. Geological Survey
Donna Collins, Colorado Geological Survey
Steve Craig, Bear Creek Mining Company
Claude Dean, ARCO Exploration Company
Rick Egloff, Central Rocky Mountain Mining Association
Doc Ellis, U.S. Bureau of Mines
Russ Frum, Colorado Mining Association
Eliseo Gonzalez-Urien, Noranda Exploration, Inc.
Ron Graichen, AMOCO Minerals Company
Bob Hawkins, Freeport Exploration Company
Al Hornbaker, Colorado Geological Survey
Bob Horton, Bendix Company
Bruce Johnson, U.S. Geological Survey
Steve Kluender, U.S. Bureau of Mines
Bob Lamarre, Noranda Exploration, Inc.
Dave Lindsay, U.S. Geological Survey
Bill Martin, Martin-Trost Associates
Larry McDaniel, ARCO Exploration Company
Jay Mitchell, Anaconda Company
Shirley Paul, Kansas Geological Survey

Dick Pearl, Colorado Geological Survey
Chuck Spencer, U.S. Geological Survey
Karl Starch, U.S. Bureau of Mines
Tom Steven, U.S. Geological Survey
Jack Swenson, Rocky Mountain Oil and Gas Association
Dick Taylor, U.S. Geological Survey
Tommy Thompson, Colorado State University
Margo Toth, U.S. Geological Survey
Paul Trost, Martin-Trost Associates
Ogden Tweto, U.S. Geological Survey
Mersch Ward, Homestake Mining Company
Bob Wood, U.S. Bureau of Mines

The determination of mineral resource potentials is based on available data, interpretations, and professional judgment. The information on the accompanying maps is displayed in four levels, High-Medium for locatables, and for leasables; Low for locatable and leasable, and No and Unknown for leasables.

POTENTIAL MATRIX[1/]

CRITERIA	HIGH	MEDIUM	LOW	NO	UNKNOWN
Favorable geology and structure.	Minerals occurring in several mining districts; current exploration or development activities.		Insufficient data available.	Knowledge indicates no favorability.	Lack of knowledge
Mineral occurrences and known reserves.	Occurrence being developed or high prospect of success.	Extension of known reserves or occurrence deemed probable ore deposit or producing field.	Occurrence reviewed by mineral examination and considered non-economic or undiscovered reserves.	No known resources.	No known resources.
Field activities.	Activity leading to development of a mine or field.	Seismic drilling coring, trenching.	Claims, leases, sporadic assessment work.	Sporadic field work.	Basic exploratory field work, claims, leases.

1/ All items in this matrix are of a general nature. The field activities are intended to give a basic idea of what might take place on the ground.

(J. S. DERSCH, November 1979, revised February 1984)

MINERAL ELEMENT LEVEL 1

Areas in this Level contain known producing sites or mineral reserves.

These areas are currently, or probably will be, experiencing development and production of mineral reserves. Mineral-related activities will take place during the lifetime of the plan. Exploration will search for additional reserves adjacent to, or further delineate, a known mineral deposit. Current production continues during the lifetime of the plan, depending on the mineral economy and the amount of ore remaining. Current levels of activities in these areas can be expected to remain constant or even increase. The development of private land and minerals within the Forest boundary may affect adjacent Forest land and the objectives for planned surface resource management.

Forest Action. Only surface management programs that are compatible with the mineral activities should be considered in these areas. Access to the producing sites will exist, but access and special use permits to the extended reserve areas may be needed during the first ten years of the plan.

MINERAL ELEMENT LEVEL 2

Areas in this Level contain High to Medium potential for valuable deposits of minerals locatable under the General Mining Laws. The method of developing mineral deposits remains uncertain until sufficient knowledge of the mineralization is obtained.

Activities in this Level on unpatented mining claims will include exploration, such as surface sampling, trenching, and drilling which, if significant surface disturbance results, must be covered by an operating plan. Development and production may follow if an economical ore body is delineated. The potential for mineral activities is high.

Forest Actions and Controls. Capital investments, particularly existing recreational facilities, could be jeopardized by mining operations. Mineral-related activities will usually have minimal effect on programmed goals and objectives for other resources, including timber, range, wildlife, and water. Methods of exercising the right of ingress and egress given to the miner by law shall be consistent with what is needed and with necessary surface resource protection measures. Applicable Federal and State environmental statutes will be observed. Rehabilitation should be consistent with the goals and objectives for the areas as described in the plan. Regulation of activities on mining claims, if patented and thereby no longer in Federal ownership, is under the sole jurisdiction of the State. Also to be considered are the effects of activities that take place on private lands which are adjacent to National Forest System lands.

MINERAL ELEMENT LEVEL 3

Areas in this Level contain High to Medium potential for leasable minerals. Extraction is authorized by a lease issued by the Department of the Interior, subject to Forest Service recommendations or consent, as may be applicable, and to Forest Service stipulatory requirements for surface resource protection and reclamation. Development methods for oil, gas, and geothermal resources will be by well facilities, with associated surface equipment and installations. Development methods for other types of minerals remain uncertain pending sufficient knowledge of the deposits.

Activities in this Level will be exploration, including but not limited to photogeologic mapping, seismic and resistivity work, and drilling, covered by a lease or a prospecting permit (the latter may be issued by the FS or BLM, depending on the situation).

The granting of a prospecting permit by the Forest Service does not grant any rights to or for development of a deposit should one be found. Development and production will follow if an economical mineral deposit is delineated. The potential for the occurrence of mineral-related activities is high.

Forest Actions and Controls. Capital investment, particularly developed recreational facilities, could be jeopardized as the result of mineral-related activities in and adjacent to these areas. Mineral-related activities will have minimal effects on programmed goals and objectives for other resources, including range and wildlife. The means of access shall be consistent with the leaseholder's needs and measures necessary for protection of surface resources. Applicable Federal and State environmental statutes will apply where appropriate. Rehabilitation should be consistent with the goals and objectives for the area as described in the plan.

MINERAL ELEMENT LEVEL 4

Areas in this Level have Low potential for valuable deposits of locatable and leasable minerals. The probability that mineral extraction will occur within the first ten years of the plan is low. Prospecting may or may not find valuable deposits. Even if it does, considerable time is still necessary to acquire the necessary authorizations and to prepare for production. Some areas are considered low in mineral potential, not because there is no mineralization, but because of the current lack of knowledge about the area at this time. Exploratory activities may increase in these areas if commodity demands increase, if known reserves become depleted, if new information about the genesis and geologic environments of valuable deposits is disclosed, or if new advances in exploration technology occur.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 5

Areas in this Level are considered to have No potential for specific leasable minerals. Based on today's knowledge, mineral related activities will be very limited to non-existent. New information about the genesis and geologic environments of valuable deposits could initiate basic exploration activities, but the probability of any mineral extraction within the first ten years of the plan is very low.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 6

Areas in this Level have Unknown potential for specific leasable commodities. These areas may have High, Medium, Low or No potential but are classed as Unknown because there is little or no data available and because the geologic environment, e.g., volcanic cover, masks the situation.

Mineral activities will be limited to basic exploration due to the unknown factor. As data are obtained, and if the mineral resource potential increases, the type and amount of activity will increase. The probability that mineral extraction will occur within the first ten years of the plan is low. Should a major discovery be found, it will take considerable time to prepare for production and obtain the necessary authorizations.

As the resources in the High and Medium potential areas are depleted, these areas will become targets for continued mineral exploration.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 7

This Level is concerned with the mineral estate status, specifically non-Federal ownership of the minerals or withdrawals from mineral entry. Areas in this Level contain High, Medium, Low, No or Unknown potential for valuable deposits of minerals that would be locatable or leasable if in Federal ownership. Included in these areas are mineral rights reserved or outstanding in third parties. Reservations are minerals retained when the surface was acquired by the Government. Outstanding rights are minerals that were retained by transactions prior to Federal acquisition of the surface. The minerals are private or state owned ("alien") while the surface is Federal and managed by the Forest Service. Some reservations may be subject to the Secretary's rules and regulations contained in the original deed. The rules and regulations provide for some surface resource management control. Some reserved minerals will return to Federal ownership as acquired status during the life of the plan.

Activities within this Level involving reserved or outstanding minerals will be exploration, production, and development. The type of mineral sought will determine the specific action at each activity level. These actions could have a major impact on Forest surface resource management programs. The potential for mineral activities in this Level is uncertain.

All mineral withdrawals are included in this Level. Each withdrawal should be reviewed to determine whether or not it applies to the Mining Laws and/or the Mineral Leasing Laws and to determine accurately the tracts of land involved. These tracts should be shown on a map overlay. The land manager should review this overlay when an operating plan is received since the proposed activity may be affected by a withdrawal.

Forest Actions and Controls. Capital investments, particularly developed recreation, could be jeopardized as the result of mining activity in and adjacent to areas of reservations or outstanding rights. The alienated rights and mineral values must be considered in surface resource allocation proposals.

MINERAL ELEMENT LEVEL 8

This Level contains materials known as "salable" or "common varieties." Inservice use of these materials would be for building and maintaining timber sale roads and forest system roads. Common variety materials may be disposed of through special use permits with appropriately determined fees. Common varieties may include clay, sand, gravel, and some types of decorative rock. Each permit will require stipulations for protection of the surface resources. The method of development for these resources will be dependent upon the location and nature of the deposit.

Forest Actions and Controls. The sale of minerals does not limit the right of the U.S. Government to use the surface of a sale area and to issue permits and licenses that do not interfere with the purchaser's production of minerals. The land must be reclaimed as required by applicable law and the sale contract when common variety production is completed.

MINERAL ACTIVITIES

COLORADO

In 1983, approximately $350 million worth of non-fuel minerals were produced in Colorado (Starch, 1984). There is a wide range of commodities produced from the Forests, some of which are molybdenum, gold, silver, sand and gravel, coal, oil, natural gas, and gem stones.

In 1983, Colorado was the leading producer of vanadium and carbon dioxide; second in tungsten and molybdenum; third in lead; fifth in zinc; seventh in gold; eighth in silver; and tenth in iron ore. The latest rankings for energy fuel production shows Colorado tenth in natural gas, twelfth in coal, and fourteenth in crude oil. The State ranks third in uranium reserves, fifteenth in petroleum, ninth in natural gas and eighth in coal (Dept. of Energy, 1983). Mining is the fourth largest industry in the State.

SUMMARY:

There are many mining districts on the Forests, some of which are active today. The Climax Mine, which produces tungsten, tin, monazite and pyrite in addition to molybdenum, along with several small operations in the Alma-Como area, and the Monarch Quarry are currently active operations. Exploratory activity is taking place in the Upper Arkansas Valley, Sangre de Cristo Range, and South Park. In addition to the molybdenum, base and precious metals, iron, pegmatite minerals, limestone, uranium, gem minerals, and fluorspar are found on the Forests.

There is petroleum and natural gas production on the Grasslands. Geothermal potential exists at Mt. Princeton and Poncha Springs. Coal is being mined in the Spanish Peaks Area. Other leasable minerals on the Forests include carbon dioxide and potassium.

There are numerous clay deposits, areas of construction materials and dimension stone.

GEOLOGIC SETTING:

The Front Range is a broad flat-topped arch or anticline that consists of Precambrian Silver Plume and other granitic rocks. To the west is South Park, a flat-to-rolling basin consisting of sedimentary rocks occasionally appearing as hogbacks. This basin is the result of numerous uplift and erosion cycles during Mesozoic and Tertiary times (DeVoto, 1971). South Park is bordered on the west by the Mosquito Range, Arkansas Hills on the southwest, and the volcanic origin Thirty-nine Mile Mountains on the south. The Mosquito Range is a fault-block granitic system which borders the graben Upper Arkansas Valley on the east. The graben is a northern extension of the San Luis Valley, part of the Rio Grande Rift Zone (Chapin, 1971). The Sawatch Range is the western edge of the Upper Arkansas Valley.

The Sangre de Cristo Range, from Salida south to Fort Garland, is composed of tightly folded and thrust-faulted sedimentary rocks mixed with Precambrian-aged igneous and metamorphic rocks. To the south of the Front Range is the Precambrian-aged igneous and metamorphic complex Wet Mountains. The Spanish Peaks are two Tertiary intrusives composed of syenodiorite and a granodiorite porphyry (Johnson, 1968). The peaks intruded Tertiary-aged sedimentary rocks and are ringed by Tertiary-aged dikes ranging in composition from granite porphyry to diorite porphyry.

The grasslands are composed of sedimentary layers which form the Hugoton Embayment. The shallow basin, a northwestward extension of the Anadarko Basin, is controlled by the Cimarron Arch to the southwest, Apishapa Uplift to the west, and the Las Animas Arch to the north. Tertiary-aged sediments fill the major drainage areas.

LOCATABLE MINERALS:

Current mining activities can be found throughout the Forests. Development and production activities include the CF&I Monarch Limestone Quarry, several base and precious metals operations in the Alma-Como area, and the Climax Mine. Exploration activity is centered in the Sawatch, Mosquito, and Sangre de Cristo Mountains, and the South Park Area.

COLORADO MINERAL BELT

The Leadville, Salida, and South Park Ranger Districts are all located within the Colorado Mineral Belt. This area is a narrow but irregular shaped zone trending southwest from Boulder through Leadville to Durango. Most of the State's metal mining districts lie within this area.

The belt is characterized geologically by intrusive igneous rocks and associated ore deposits of Cretaceous and younger age and, in some places, by fissures and veins of northeasterly trend (Tweto and Case, 1972). The intrusive rocks typically are porphyries in stocks, laccoliths, sills, and dikes. The associated ore deposits are found as veins, replacement bodies, and stockworks. Parts of the Mineral Belt are interconnected by northeast trending Precambrian faults and shear zones. The geology within the Mineral Belt is the same as it is in adjacent areas. However, a major negative gravity anomaly found along the belt in the Leadville area suggests it is an expression of an underlying batholithic body.

Mineralizing solutions may have risen from the batholithic complex and become the source for many of the mineral deposits. The mineralization may be localized and differ in both age and composition from adjacent deposits. Areas considered as most favorable for the deposition of valuable minerals have been the intrusives of middle Tertiary age.

UPPER ARKANSAS VALLEY AREA

Within the Upper Arkansas Valley, the Leadville area has had the earliest and longest continuing mining and exploration activity (U.S. Geological Survey, 1964; Del Rio, 1960; Singewald, 1955; Behre, 1953; Vanderwilt, 1947; Emmons, et al., 1927).

Gold, silver, lead, and zinc have been produced since the 1860's primarily in the Leadville Mining District. The value of minerals produced varies, but the Leadville District, which includes the California, Iowa, Evans, and Empire Mining Districts, produced over $500 million worth of minerals. Precious and base metal ores in the Leadville area and neighboring mining districts are found in vein, stockwork, and blanket deposits. The blanket deposits are replacement mineralization in the Leadville limestone which is locally capped by a porphyry sill or shale bed.

Areas with potential for precious and base metal deposits include the Sawatch and Mosquito Ranges, particularly where past production has taken place. The increase of gold to $800 per ounce in early 1980 and continued value of around $400 per ounce started new exploration and has allowed other areas to continue. Activity today has slowed considerably due to a lower gold price and a sluggish economy.

The St. Kevin-Sugarloaf Mining District is located west of Leadville near Turquoise Lake. Silver was produced mainly from oxide ore, but locally, gold, lead, and zinc were important. The veins, which contain massive sulfides, and the granite wallrock have been strongly altered by hydrothermal action. About $12,000 of gold, silver, lead, and zinc were produced from 1933 to 1945.

The Twin Lakes (Lackawanna Gulch) Mining District produced gold and silver along with some lead and zinc. Production of the small veins was limited to the mid-1930's when about $67,000 worth of gold, silver, and lead were mined. The Tertiary age veins are found in Precambrian granite. The district is located west of Granite on Lake Fork.

Placer gold was first found in the Leadville area in 1860 (Parker, 1974a and b). Exploration continued and gold was found in the Buena Vista-Twin Lakes area. Most of the placer deposits have been reworked and redeposited by glacial action. Over 400,000 ounces of placer gold have been hydraulicked, sluiced, and dredged in Lake and Chaffee Counties.

Molybdenum from the Climax and Henderson Mines, which accounted for approximately two-thirds of the State's 1981 non-fuel mineral production, resumed production in 1984 at reduced levels. Exploration indicates additional molybdenum mineralization is located in the Clear Creek Mining District that may be economical (Barker, 1979). These areas are East Red, Winfield Peak, Middle Mountain, Cloyses Lake, Lake Fork, and Mount Hope. There are other sites in the Clear Creek District along with the Mt. Aetna-Hoffman Park area and the northern end of the Mosquito Range (U.S. Geological Survey, 1964). The ore is dispersed through areas of altered and fractured rocks commonly in or near intrusive bodies. These areas may be favorable

for large tonnage, low grade ore bodies. Molybdenum is used in steel to increase the hardness, toughness, and resistance to wear and corrosion.

The Calumet (Whitehorn) and Turret Creek Mining Districts are located about 16 miles northeast of Salida. Vanderwilt (1947) noted that gold, silver, and copper occurred in small veins but there is no recorded production for the Calumet Mining District. Iron ore was first produced in the 1880's from the Calumet Mine in the Turret Creek Mining District (U.S. Geological Survey, 1964). The mine ceased production in 1899 when the percentage of iron dropped too low to be produced economically. The ore is in Mississippian limestone adjacent to a Tertiary intrusive. Future needs for iron ore may result in further exploration of this area. Feldspar, mica, and rare-earth minerals have been produced from feldspar mining in this district (Del Rio, 1960).

The Chalk Creek Mining District includes the Alpine, Hancock, Romley, and St. Elmo areas (Dings and Robinson, 1957). Mining started in 1875 when a mill was constructed to treat ore from several mines including the Mary Murphy group of mines. The value of gold, silver, lead, copper, and zinc produced exceeded $5.9 million, 75 percent of which came from the Mary Murphy Mine. The major mines were the Mary Murphy, Iron Chest, Allie Belle, and California. The Mary Murphy Mine, which is located about two miles south of St. Elmo, consisted of pyritic quartz veins from which 110,000 ounces of gold and 971,000 ounces of silver were recovered.

The Cottonwood Mining District is located north of St. Elmo near Cottonwood Pass (Vanderwilt, 1947). There are veins carrying lead, silver, and gold in the Precambrian granite and schist, but no records of any production.

The Monarch Mining District is located south of St. Elmo on the east side of Monarch Pass (Dings and Robinson, 1957). The mineralization occurs as either bedded or irregular forms and along faults in limestone and dolomite, or as veins in the Mount Princeton quartz monzonite. The total value of precious and base metals from the district exceeds $13 million. The Garfield Mine on the east side of Taylor Gulch started in the 1880's. The replacement mineralization consisted of galena, sphalerite, pyrite, and some chalcopyrite in the Manitou dolomite. The Madonna Mine is located in the northwest slope of Monarch Ridge. The mine was discovered in 1878. Through 1950 precious and base metal production exceeded $6 million. The main ore body dimensions were about 2,000 feet in length, breadth of 80 feet, and a thickness of 40 feet. Cerrusite, silver-bearing galena, smithsonite, cerargyrite, argentite and free gold were the principal minerals mined. Today, limestone is produced from the Monarch Quarry for the CF&I Steel Corporation steelmaking operations in Pueblo. Molybdenum occurrences have been reported in the Mt. Aetna-Hoffman Park area (U.S. Geological Survey, 1964).

The Buffalo Peaks Wilderness Study Area (WSA) is located in the Mosquito Range (Hedlund and Wood, 1984; Wood, 1983). Surrounding the WSA are several mining districts including Granite on the west, Weston Pass on the northeast, and Fourmile on the south side.

The Granite Mining District is located northeast of Granite on the Chaffee-Lake County line (Vanderwilt, 1947). Silver, gold, and lead are found in pyrite-quartz-gold-tourmaline veins cutting the Precambrian granite. The Gopher Shaft, Bunker Hill Shaft, Magenta Shaft, and Granite Tunnel were driven to intersect the mines on Yankee Blade Hill. Placer gold from these areas has been found along the Arkansas River along with that of the Lost Canyon Mining District located southwest of Granite.

The Weston Pass Mining District straddles Weston Pass but the majority of the activity was on the east side (Vanderwilt, 1947). The silver, zinc, and lead ores occur as replacement deposits in the Leadville limestone. The production was apparently limited to surface enrichment. The Ruby Mine contained disseminated galena, some sphalerite, along with cerussite, calamine, and smithsonite (Del Rio, 1960).

The Fourmile Mining District is located on the southern end of the Buffalo Peaks Wilderness Study Area several miles north of Buena Vista. The quartz-pyrite-gold veins in the district were worked from 1935 through 1937 when 53.5 ounces of gold was produced and in 1940 when gold, silver, copper, lead, and zinc was mined (Vanderwilt, 1947). There is no other recorded production.

There are two mining districts in the vicinity of Trout Creek Pass, Free Gold and Trout Creek (Vanderwilt, 1947). The Free Gold Mining District consisted of several silver veins cutting Precambrian granite. Production in the early 1930's was limited to some placer gold work and mining of a few tons of low-grade gold ore. The Trout Creek Mining District, from which gold, silver, lead, and zinc were recovered during the 1930's, recorded a production value of about $1,200 (Vanderwilt, 1947). In addition to the precious and base metal recovery, feldspar, mica and rare-earth minerals have been produced from pegmatite mining (Del Rio, 1960).

Several other commodities in this area include tungsten, tin, monazite, uranium, and fluorspar. Tungsten, tin, pyrite, and monazite are by-products from mining at the Climax Mine (U.S. Geological Survey, 1964; Eckel, 1961). The Marshall Pass District, where uranium is currently being mined at the Pitch Mine on the Gunnison National Forest, extends into Chaffee County (Malan, 1959).

Some manganese deposits are associated with precious, base metal, and iron mineralization in the Leadville area (U.S. Geological Survey, 1964). The size and grade of the oxidized deposits are dependent upon form and grade of the original deposit and the alteration processes. Inferred deposits exist in the Leadville area. Manganese is used in the production of ferromanganese for steel production and in chemicals and batteries.

The Browns Canyon District is one of six major fluorspar areas in the State (U.S. Geological Survey, 1964; Del Rio, 1960). The deposit consists of veins and mineralized breccias in Precambrian granitic rocks. Production occurred from the late 1920's through the middle 1940's when about 85,000 tons of fluorspar of metallurgical and ceramic grade were shipped.

SOUTH PARK AREA

The Colorado Mineral Belt extends across the northwestern corner of this area. Along the eastern edge of the Mosquito Range are five mining districts, Consolidated Montgomery, Buckskin, Mosquito, Sacramento, and Horseshoe, which produced the major portion of the lode production from this area (Vanderwilt, 1947). The principal areas of mineralization are 1) London (southwest of Mosquito Peak), 2) Loveland (on Buckskin and Mosquito Creeks), 3) Bross-Lincoln, 4) Sacramento, and 5) Hilltop (on Fourmile Creek) (Singewald, 1947a). The ore deposits are found along the footwall of the London fault, as replacement bodies of silver and lead in the Leadville limestone, and as gold and replacement veins in the Sawatch quartzite. In Park County, the Alma Mining District, composed of the Buckskin, Consolidated Montgomery, and Mosquito Mining Districts, produced $37 million of precious and base metals (U.S. Geological Survey, 1964).

Placer deposits in Park County through 1962 have yielded about 342,000 ounces of gold worth $9.4 million (U.S. Geological Survey, 1964). The South Platte Valley, Beaver Creek, and Tarryall Creek were the principal geographic areas for the placer mining. Glaciation of lodes in the mountains to the north and west created the placer deposits. The most productive of the glacial features were the outwash gravels (Singewald, 1947b). Today there are several small operations in the Alma and Como areas. The current gold price of $400 per ounce has caused recent exploration to slow down. Any upturn in the price may revive exploration activity.

The potential for uranium occurs around the edge of South Park, particularly the northeast at Kenosha Pass. The mineralization at Kenosha Pass is found in granitic rocks either as veins or as lenses and pods adjacent to metasediments. The current lull in the economy caused both operations to permanently shut down. To the southeast, exploration geologists are looking for deposits in ancestral drainages similar to the Tallahasee Creek Project on the southeastern edge of the Thirtynine Mile volcanic field. Tarryall Springs, Thirtynine Mile Mountain, and the Arkansas Hills (Fremont County) east of Salida have potential for uranium mineralization, possibly similar to Tallahasee Creek.

Tungsten as scheelite and powellite occurs in the Tarryall Springs District northwest of Lake George (U.S. Geological Survey, 1964). The tungsten minerals occur in parallel bands of calc-silicate gneiss on the western edge of the Pikes Peak Batholith. There has been no known production.

On the southeast side of South Park is the Badger Creek Mining District (Vanderwilt, 1947). Copper mineralization has been reported, but there has been no known production.

There are numerous occurrences of fluorspar and pegmatite minerals in the South Park area (U.S. Geological Survey, 1964; Del Rio, 1960). There are fluorspar veins in the Jefferson District west of Kenosha Pass, the Lake George area, and the Silver Dollar Deposit in the Tarryall District. The pegmatite occurrences are centered in the Lake George area. The sites have been mined chiefly for feldspar, but some rare-earth minerals have been recovered from the operation in addition to beryl.

The first beryllium vein deposit in the United States to be mined was the Boomer Mine in Park County (Hawley, 1969). The mine is located on the southern edge of a fine-grained granitic intrusive, the Boomer Cupola. There are several adjacent areas, China Wall, Redskin Gulch, and Mary Lee that have inferred reserves. The metal is used in alloys and in inertial guidance systems.

PIKES PEAK AREA

This area consists of pegmatites, fluorspar deposits and gemstone occurrences. The two main areas are the St. Peter's Dome-Mount Rosa Area (U.S. Geological Survey, 1964; Del Rio, 1960) and the South Platte District (Simmons and Heinrich, 1980; U.S. Geological Survey, 1964). Gemstones such as amethyst, tourmaline, smoky quartz, amazonite, quartz crystal, and topaz can be found in the St. Peter's Dome-Mount Rosa area. The Tertiary-age fluorspar deposits in this area occur in veins and breccia fillings along faults with minor occurrences of barite, galena, sphalerite and pyrite. Rare-earth, thorium, niobium-tantalum, and beryllium minerals occur in the pegmatite zones found in the Pikes Peak granite. The Cripple Creek pegmatite province, located along the margins of the Pikes Peak Batholith west of St. Peter's Dome, contains topaz, quartz, and amazonstone, but no other economic minerals.

The South Platte District has several areas that contain fluorspar, pegmatites, and gemstones. These are the Buffalo District, South Platte Pegmatite District, and three smaller prospects located to the southeast in Douglas County. Minerals mined from these pegmatites include feldspar, quartz, fluorite, and rare-earth minerals. Deer Trail, Yammy Yogurt, Shuttle Run, Little Bill, and Madonna No. 1 are several of the pegmatites that were mined.

The Blair Athol Mining District is located about six miles northwest of Colorado Springs (Vanderwilt, 1947). During 1913 and 1914 ore mined yielded 13,276 pounds of copper. The district is located in Precambrian granite, but there was no description of the occurrence.

WET MOUNTAINS AREA

There are two mining districts in the Wet Mountains area, Fairview and Grape Creek (Vanderwilt, 1947). The Fairview Mining District is located about 12 miles southeast of Silver Cliff. There are no production records or reported occurrences. The Grape Mining District is west of the Yorkville site on Grape Creek. There are no production records, but some lead and zinc ore was mined.

The Oak Creek (Ilse, Spaulding) Mining District is located on the west side of this area around Ilse (Vanderwilt, 1947). Cerrusite deposits at the Terrible Mine on the east side of Oak Creek have been mined. The deposits are found as lenses, stringers, and small pockets in the granite and granite-gneiss bedrock. Prior to 1895, around 300,000 tons of five to eight percent lead were produced, but activity has been limited since and ceased after 1943. The Feldspar Mine is centered around a one to seven

foot barite-galena vein which outcrops for 1,000 feet on the surface in Precambrian gneiss and schist. The mine is located three miles north of Ilse on the west edge of the Wet Mountains area.

The Greenhorn Wilderness Study Area (WSA) has been studied by the U.S. Geological Survey and the U.S. Bureau of Mines (Toth and Baskin, 1984; Baskin, 1983). Stream sediment sampling indicated that barium, lanthanum, yttrium, and tungsten anomalies are present in the South Apache Creek drainage. Areas with similar Precambrian rocks have demonstrated tungsten resources even though no mineralization was noticed on the surface. The WSA is located on the southern end of the Wet Mountains area near Badito Cone.

Fluorspar, uranium, thorium, and vermiculite are found in the Wet Mountains. The Antelope Creek District consists of small fluorite veins which at one time were mined. Uranium in the Stumbling Stud Mine occurs along the Cretaceous Dakota rhyolite-sandstone contact (U.S. Geological Survey, 1964). The uranium mineralization is associated with fluorite-bearing fractures and as disseminated grains in sandstone. Thorium occurs in a northwest trending shear zone containing barium-sulfide veins within a Precambrian igneous rock complex (Del Rio, 1960). During 1958 and 1959 thorium was mined from the vein system in carbonatite rocks between Queida and Rosita. Sampling of the vein system indicated the ThO_2 content ranges from 0.02 to 12.5 percent (U.S. Geological Survey, 1964).

Vermiculite, an expandable micaceous clay used as an insulator or aggregate in concrete, occurs in veins about six miles northwest of Rye (Del Rio, 1960). The veins up to six inches thick are found in roughly vertical alteration zones in peridotite which was emplaced as dikes in Precambrian pink granite.

SPANISH PEAKS AREA

Small veins of gold, silver with some copper, and lead occurs in fissure veins around West Spanish Peak in metamorphased sedimentary rocks. Vanderwilt (1947) noted the veins also contain pyrite, sphalerite, and siderite. There are several prospects on West Spanish Peak, but the Bull's Eye Mine was the most prominent. Mine production was limited to 1908 when 168 ounces of gold and 1,176 ounces of silver were mined (Vanderwilt, 1947). Budding and Kluender (1984) found geochemical anomalies for lead, zinc, silver, copper and gold in the zone of contact metamorphosed sedimentary rocks around the intrusive of West Spanish Peak.

Placer gold was recovered in the Wahatoya Creek and on the tributaries of Apishapa River on West Spanish Peak. Recovery was limited in sampling conducted by the U.S. Bureau of Mines for the Spanish Peaks Wilderness Study Areas report.

SANGRE DE CRISTO AREA

The Cleora Mining District is located southeast of Salida on the northern end of the Sangre de Cristo Range. Chalcopyrite occurs in Precambrian schist, but there are no records of any production (Vanderwilt, 1947).

U.S. Geological Survey (1964) reported that scheelite occurs in Precambrian age copper-quartz veins of several copper mines of the Cleora Mining District.

Uranium, fluorspar, molybdenum, and copper occurrences have been reported (U.S. Geological Survey, 1964; Del Rio, 1960). Uranium occurs along the east flank of the Sangre de Cristo Range in mildly metamorphased sandstones and mudstones of Permian and Pennsylvanian age. A known bedded deposit exists in the Crestone Needles area. Poncha Pass and Poncha Springs are two fluorspar areas in Chaffee County. The deposit at Poncha Pass consists of a shear zone with fluorite and a gouge zone that cut Precambrian quartzites and schists. At one time there were at least four mines in the Poncha Pass area. The Poncha Springs fluorspar mine is a north-south trending vein in a 100 foot wide shear zone in Precambrian granite. There are no records of production from either area.

There are two molybdenum occurrences on the east side of the Sangre de Cristo Range. The Knight-Stacy prospect is a vein occurrence on the east side of Cottonwood Peak (King, personal communication). A quartz vein with pyrite, chalcopyrite, and an average of less than one percent MoS_2 is exposed on the surface. Alteration halos are visible on the surface, probably the result of an intrusive which has poked up through the sediments. The second occurrence is a pegmatite on the east side of Mosca Pass.

The Sangre de Cristo Wilderness Study Area is being jointly studied by the U.S. Geological Survey and the U.S. Bureau of Mines (Johnson, et al., 1984; Ellis, et al., 1983). Four areas of resource potential were defined by Johnson (et al., 1984). Four of the areas lie adjacent to the western edge of the Study Area on the northwest trending Sangre de Cristo Fault, totally within the Rio Grande National Forest. These areas have potential for gold, silver, iron, copper and lead. Northwest trending veins north of Blanca Peak have potential for gold, silver, and tungsten. The area around the Rito Alto stock has potential for molybdenum, copper, tungsten and gold.

COMANCHE-SPRINGFIELD AREA

The Carrizo Creek (Estelene) Mining District is located about 45 miles southwest of Springfield. Activity was limited from 1900 to 1917 when about $4,900 worth of copper ore along with some gold and silver was mined (Vanderwilt, 1947). Chalcocite, partly altered to malachite and azurite, occurs in sandstone. Del Rio (1960) noted there were plans for strip mining this deposit, but no activity has taken place to date.

LEASABLE MINERALS:

The Cottonwood Creek-Chalk Creek and Poncha Springs geothermal areas have good potential for electrical production (Pearl, 1979). Lease applications have been filed for both of the Arkansas Valley areas. Currently, production is limited to domestic uses and space heating.

The reservoir systems for both areas are similar. In the Cottonwood Creek-Chalk Creek area, the hot waters are related to the faulting and fracturing of the Mount Princeton quartzite. Surface waters descend in fault systems west of this area or in valley fill to the east and rise through the Mt. Princeton fault zone to feed local springs. Poncha Springs consists of five springs fed by waters probably from the valley fill. The complex faulting system of the area allows the waters to reach the surface.

The potential of each reservoir is dependent upon the size of area and the subsurface temperatures. The estimated subsurface temperature for Cottonwood Creek is 105° to 182°C and for Chalk Creek is 150° to 200°C. The heat content is estimated to be 3.81×10^{15} BTU's. Poncha Springs' subsurface temperature is estimated to be 115° to 145°C with a heat content of 1.911×10^{15} BTU's. Cottonwood Creek-Chalk Creek has a potential for 100 megawatts of electricity and Poncha Springs has the potential for 200 megawatts.

The Forest has two coal resource areas, South Park Field and the Raton-Mesa Region (Nielsen, 1981; Jones, et al., 1978). The South Park Field touches the Forest north of Jefferson. There is no production from the coal-bearing rocks of the Laramie Formation. The Raton-Mesa Region, a Known Recoverable Coal Resource Leasing Area, consists of the Walsenburg and Trinidad Fields. The coal-bearing rocks in this Region are the Raton and Vermejo Formations of Upper Cretaceous age. The only mining activity from the Walsenburg Field is the Viking Strip Mine, located off the Forest, which produced 37,106 tons of coal in 1981 (Colorado Mining Association, 1982). Good coking coal from the Trinidad Field is mined on the Forest. CF&I Steel Corporation's Allen and Maxwell Mines produced 661,889 tons of coal in 1981 and employed 515 people (Colorado Mining Association, 1982).

Oil and gas production activities are restricted to the Grasslands (U.S. Geological Survey and Colorado Geological Survey, 1977; U.S. Geological Survey, 1964). Currently, there are two producing and five "shut-in" gas fields in the Carrizo District. Production from the Vilas and Playa Fields for 1981 was about 2.006 million cubic feet (Colorado Oil and Gas Cons. Comm., 1982). The fields are stratigraphic traps of Pennsylvanian age.

There are several areas with high to medium potential for oil and gas (Spencer, 1983, 1979). Additional reserves in Paleozoic sediments are probable in the Hugoton Embayment area of southeastern Colorado. Assessment of the oil and gas potential in the Sangre de Cristo Range, particularly the southern part, is difficult because of the structural complexity. The Sangre de Cristo Range is a horst block of Laramide time folded and faulted Precambrian and Paleozoic rocks which are bounded on the east by the Alvardo Fault and the Wet Mountain Valley Graben, and on the west by the Sangre de Cristo Fault and the San Luis Valley Graben (Johnson, et al., 1984). This band of folded and faulted rocks crosses the Forest on a southeast trend from a point south of Mount Marcy and exiting near Medano Pass. The overthrusted zone continues to the east of Slide Mountain and on through Pass Creek Pass area. The southeast trend continues, and includes the western portion of the Spanish Peaks. Known hydrocarbon source rocks occur in Huerfano Park, but are not exposed in the Forest. The crustal shifting of the rock layers from the west may have created potential structural traps adjacent to the east side of the Forest that could contain

oil and gas reserves. A detailed analysis of the structure of this area requires subsurface and seismic profile data not presently available. If favorable rocks such as Cretaceous sandstone and shale extend under the Forest beneath the thrusting, the area underlain is relatively small and details of its subsurface structure are unknown. The eastern flank of the Sangre de Cristo Range along the Forest boundary from Slide Mountain north to Bradford should be considered medium potential (see Mineral Potential Overlay). The remainder of the Forest in the Sangre de Cristo Range is rated low potential except for the extreme northern end that is rated no potential (Spencer, 1983).

A known carbon dioxide area exists in the central portion of the Springfield District. Interest has been shown by major companies, but activities have been limited. The gas is used to flood oil and gas zones for increased production.

A potential deposit of potassium exists near Porphyry Peak southwest of Salida. Alunite is a secondary mineral formed principally from the actions of acid sulfate solutions forming replacement or disseminated-type deposits. A prospecting permit was applied for but withdrawn in 1983.

SALABLE MINERALS:

Refractory and clay shale deposits exist along the Front Range in the Dakota sandstone in Douglas County and Pueblo County (U.S. Geological Survey, 1964; Del Rio, 1960). The clays from the Rampart Range area are used for bricks, refractory goods, and stoneware. A small deposit of bentonite has been mined for local use at the Triangle-Lamberg Mine east of Salida.

Sand and gravel is available in all counties. The main sources are alluvium and terrace gravels along the South Platte and Arkansas Rivers and their tributaries. A quarry in Lake County near Sylvan Lakes has produced a sand and gravel product with uses varying from concrete to finishing work since the middle 1950's.

The Colorado Springs area has several places which produce stone, granite, and sandstone for construction purposes. A red granite quarry near Buffalo Creek has produced a dimension stone used for building in Colorado, Wyoming, and Nebraska (Del Rio, 1960).

Gem minerals, aquamarine and turquoise, have been found and mined in the Upper Arkansas Valley area. Aquamarine crystals, a form of beryl, have been recovered from the California Mine on Mount Antero (Del Rio, 1960). The beryl, possibly up to ten percent BeO, occurs in molybdenum-rich veins. The Turquoise Chief Mine is located about seven miles northwest of Leadville (Eckel, 1961). During 1935, one thousand pounds of gem-quality turquoise was mined from veins and nodules in white granite.

FUTURE AREAS FOR EXPLORATION:

In addition to the current activities described in the locatable and leasable minerals section, the following areas may be targets for future mineral exploration within the Forests and Grasslands:

1. Leadville area for precious, base, and molybdenum mineralization.

2. Clear Creek Mining District for molybdenum deposits.

3. Boreas Pass-Webster Pass area for base and precious lode and placer deposits.

4. South end of South Park and Arkansas Hills areas for uranium in ancestral drainages.

5. Mosquito Range for replacement and blanket precious and base metal deposits.

6. Glacial deposits in the South Platte and Tarryall Valleys for placer gold.

7. Geothermal energy in the Upper Arkansas Valley area.

8. Eastern flank of the Sangre de Cristo Range for uranium, oil, and gas.

9. Springfield District for oil, gas, and carbon dioxide reserves.

MINERAL ACTIVITIES

KANSAS

The mineral industry of Kansas consists of two segments--mining and manufacturing. The mining segment involves the development and production of raw minerals while the manufacturing segment concentrates on processing the commodities into semi-finished or finished products. The sand and gravel operation in Morton County contributed only slightly to the non-fuel mineral production for 1983, which was $283 million (Hill, 1984). Kansas was ranked first in the Nation for helium production, the majority of which came from the southwest corner of the State. Cement, salt, and crushed stone continue to be the leading commodities produced in the State.

Kansas ranks eighth in petroleum reserves, sixth in natural gas and twenty-first in coal (Dept. of Energy, 1983).

SUMMARY:

The potential for locatable mining activity is low.

Petroleum and natural gas account for nearly all of the mineral value produced from the Grassland. Helium and natural gas liquids are produced at local facilities. The potential for commercial salt production is low.

There is one operating sand and gravel pit.

GEOLOGIC SETTING:

The Grassland lies in the Hugoton Embayment, a shallow shelf edge on the northwestern edge of the Anadarko Basin (Rascoe, 1971). The embayment is controlled on the west by the Las Animas Arch in eastern Colorado and to the southwest by the Cimarron Arch in western Oklahoma. Tertiary-aged sediments are found in the Cimarron River drainage.

LOCATABLE MINERALS:

There is no mining claim activity at this time and the potential for such activity is considered low.

LEASABLE MINERALS:

Oil and gas is being produced from 17 oil and gas fields within the Grassland boundary (Oros, 1975). In 1982, Morton County oil production exceeded 860 thousand barrels, and gas production surpassed 12.5 million cubic feet (Paul, personal communication). Rocks of Permian, Pennsylvanian, and Upper Mississippian age are the sources for the oil and gas. In Morton County, the oil and gas reservoirs are found in stratigraphic traps.

Production methods vary within the County. Several fields are new, while older fields are using controlled water flooding for secondary recovery. The number of secondary methods of recovery will continue to increase as the rates of recovery decrease.

The potential for discovery of hydrocarbons should be considered high. The Pennsylvanian and Mississippian rocks, which are currently producing, probably contain additional reserves. Adequate formation testing has not been conducted below the current production zones, however, these rocks do have favorable conditions and structure for hydrocarbon accumulation.

About 90 percent of the ownership for oil and gas exists in reservations and outstanding rights, or non-Federal ownership. Starting in 1985, about 35 percent of the non-Federal ownership will revert back to the United States Government (Zarley, personal communication).

Helium and natural gas liquids are produced at several local facilities (McDougal, et al., 1979). Helium is processed from gas recovered from the Greenwood Gas Area and the Sparks Field. The helium potential is considered high and extends into southeast Colorado. Natural gas liquids produced include propane, ethane, liquid petroleum gas, and natural gasoline.

Two thin Permian salt beds are located in the County (Holdoway, 1978). One is the Blaine Salt, part of the Blaine Formation, and the other is the Cimarron Salt, part of the Ninnescah Formation. There is no current exploration activity or plans for development of these resources. The commercial potential is low because of impurities and minimal salt thicknesses.

SALABLE MINERALS:

There is one known sand and gravel pit operated by the Morton County Road Department (Price and Brady, 1981). The potential areas are limited to Pliocene and Pleistocene-aged materials along the major streams.

FUTURE AREAS FOR EXPLORATION:

In addition to the current activities described in the locatable and leasable mineral sections, the following areas may be targets for future mineral exploration within the Grassland.

1. Continued exploration of currently producing zones for additional oil and gas production.

2. Exploration of rocks below currently producing zones for additional oil and gas production.

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MINERAL AUTHORITY MATRIX [1/]

KINDS OF MINERALS	FEDERAL MINERAL ESTATE STATUS	
	PUBLIC DOMAIN MINERALS	ACQUIRED MINERALS
Locatable Minerals "Valuable minerals" except as noted below.	1872 U.S. Mining Law [2/] Prospector and miner have the right to search for and take valuable deposits of "locatable" minerals and to secure title to NFS lands under certain circumstances (FSM 2810). 1974 Secretary of Agriculture 36 CFR 228 Regs. Operator required to submit Notice of Intent or, when significant surface disturbance is anticipated, a Plan of Operation is required (FSM 2810).	1947 Mineral Leasing Act for Acquired Lands Mineral leasing by Interior only with Forest Service consent (FSM 2822).
Leasable Minerals Fossil fuels, other bitumens: Potassium, Sodium, Phosphate, Sulfur in La, and N.M.	1920 Mineral Land Leasing Act Mineral leasing by Interior based on recommendation of Forest Service, except coal which requires FS consent (FSM 2822).	1947 Mineral Leasing Act of Acquired Land Mineral leasing by Interior only with Forest Service consent (FSM 2822).
Geothermal Resources	1970 Geothermal Steam Act Leasing by Interior only with Forest Service consent (FSM 2822).	
Mineral Materials Common variety - sand, clay, gravel, etc.	Act of July 31, 1947 Forest Service cannot dispose of on valid claim without consent of claimant. Can dispose of if claim is declared invalid (FSM 2850).	Act of June 11, 1960 Forest Service authorized to dispose of (FSM 2850).

[1/] In addition to these Acts concerned with the disposal of minerals and mineral materials, the Forest Service is authorized to issue prospecting permits for activities covered by the Mineral Leasing Acts on lands of the National Forest System.

[2/] Includes the 1872 U.S. Mining Law, subsequent Acts of Congress, and case law governing location and patenting of mining claims on the public domain.

APPENDIX I

APPENDIX I

MINERAL INVESTIGATION OF THE SANGRE DE CRISTO WILDERNESS STUDY AREA, ALAMOSA, CUSTER, FREMONT, HUERFANO, AND SAGUACHE COUNTIES, COLORADO

By
Clarence E. Ellis, Brian J. Hannigan, and John R. Thompson, Bureau of Mines

INTRODUCTION

In May through September, 1982, the Bureau of Mines, as part of a joint effort with the Geological Survey, completed a mineral investigation of the Sangre de Cristo Wilderness Study Area (WSA) that was begun in 1979 and recessed after one month.

Location, size, and geographic setting

The Sangre de Cristo WSA covers approximately 221,000 acres (350 mi^2) of the San Isabel and Rio Grande National Forests in south-central Colorado. The WSA is in Alamosa, Custer, Fremont, Huerfano, and Saguache Counties, and adjacent to Costilla County (fig. 1).

The WSA includes most of the northwest-trending Sangre de Cristo Mountains between Poncha Pass on the northwest, and La Veta Pass on the southeast. The WSA is about 70 mi long and 5 to 8 mi wide. The boundary generally follows the foot of the mountains except where roads or private property cause deviations (pl. 1).

The WSA is accessible by county, forest service, BLM, ranch, and mine roads from U.S. Highway 50 on the north, U.S. Highway 285 and Colorado Highways 17 and 150 on the west, U.S. Highway 160 on the south, and Colorado Highway 69 on the east (fig. 1). Colorado Highway 150 ends at the Great Sand Dunes National Monument which adjoins the WSA on the west side between Mosca and Medano Passes. North of the Monument, the WSA adjoins the Luis Maria Baca No. 4 (Baca Land Grant). The land grant is 12 1/2 mi square, and contains a triangle of the Sangre de Cristo Mountains not included in the WSA. Kit Carson

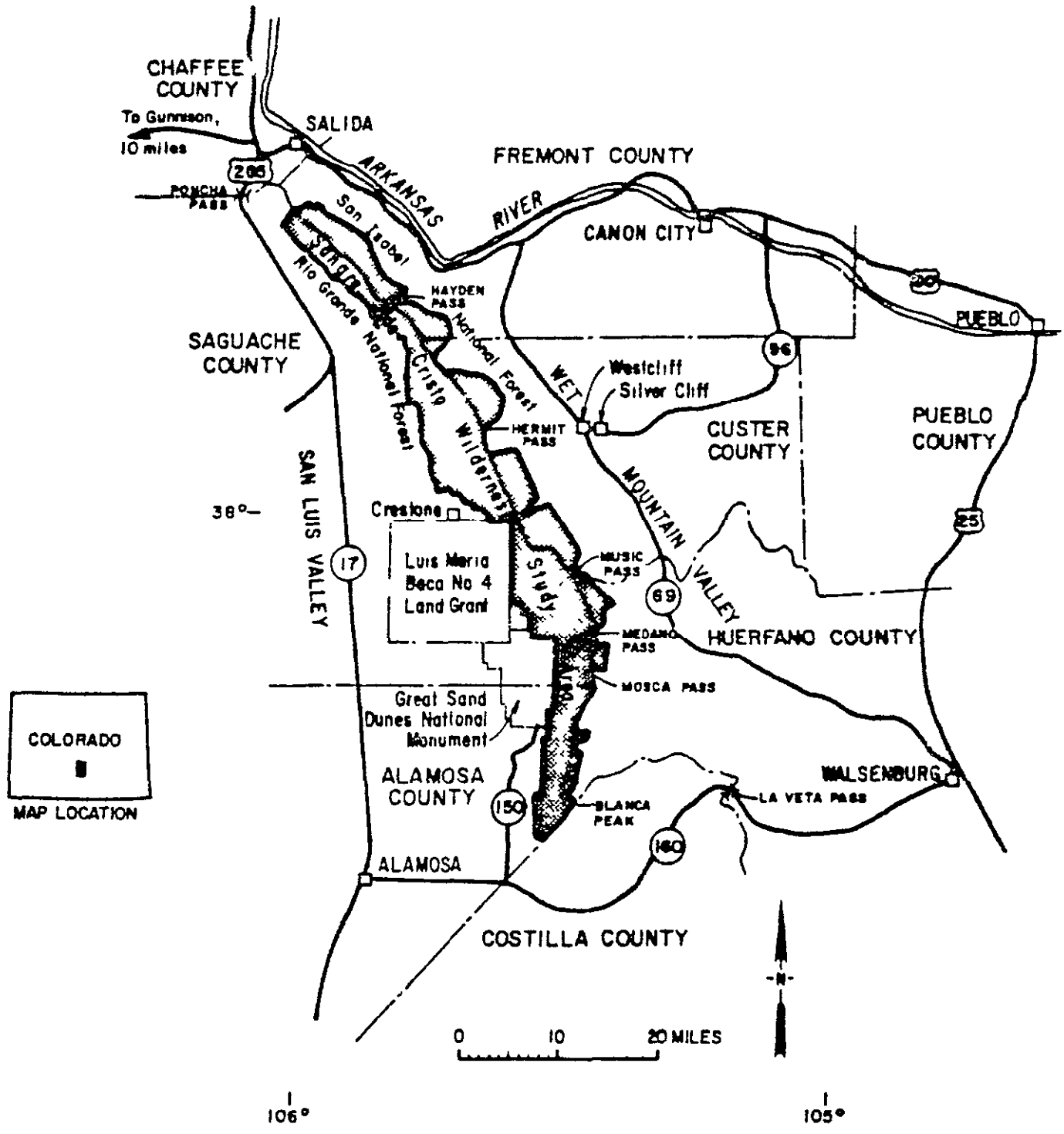

Figure 1.--Index map of the Sangre de Cristo Wilderness Study Area, Alamosa, Custer, Fremont, Huerfano, and Saguache Counties, Colorado.

Mountain, on the crest of the range, is approximately on the northeast corner of the land grant. Foot access through the grant is generally allowed, but vehicular access is restricted.

Jeep trails across Hayden and Medano Passes divide the WSA into three parts. A gravel road extends to the top of Mosca Pass from the east. About 10 mi north, the Music Pass road is drivable from the eastern base of the range to within about 1 mi of the summit. Three mine roads extend into the east side of the WSA in its central part: the South Colony road ends at an abandoned uranium mine near the 14,000 ft plus Crestone Peaks; about 14 mi farther north, the Hermit Pass road crosses the range to a uranium prospect, but is now blocked at the range crest; about 16 mi farther north there is a road to the Stamina Mine in Cloverdale Basin (pl. 1).

Principle towns of the region are Salida, about 8 mi north of the WSA; Alamosa, about 20 mi southwest; Walsenburg, about 35 mi southeast; and Canon City, about 25 mi northeast. Westcliffe and Silver Cliff, adjacent towns about 6 mi east of the WSA, are the population center in the Wet Mountain Valley. Crestone is at the western base of the range (fig. 1).

The Sangre de Cristo Mountains rise abruptly from the San Luis Valley on the southwest, and the Wet Mountain Valley on the northeast. The range crest is generally above 12,000 ft elevation except between Mosca and Medano Passes--about 15 mi north of the south end of the WSA--and near Hayden Pass--about 15 mi southeast of the northwest end of the WSA. The highest elevation is 14,363 ft on Blanca Peak at the southern end of the WSA. The lowest elevation is about 8,000 ft only 5 mi west, at the base of the range.

The Sangre de Cristo Mountains are bounded by the Alvarado fault on the northeast and the Sangre de Cristo fault--a component of the Rio Grande Rift--

on the southwest. The rocks between these faults are mostly Precambrian igneous and metamorphic rocks or Pennsylvanian and Permian clastic sedimentary rocks. Lower Paleozoic rocks are exposed along the western base of the range, and in a band crossing the northern end of the range (Johnson and others, 1983).

Previous studies

The mineral deposits in the Sangre de Cristo Mountains may be the least studied deposits in the state of Colorado. Bagg (1908) briefly examined the Rita Alta copper deposit. Worchester (1918) briefly examined molybdenum prospects in Cloverdale Basin. Stone (1934) studied the Orient iron mine. Parker (1952) reviewed the history of the Crestone gold district. Gableman (1953) defined a mineral belt which includes the Sangre de Cristo Wilderness Study Area.

Many studies have been made of the stratigraphy and structure of the range. De Voto (1971) contains a good bibliography.

U.S. Bureau of Mines and Colorado Division of Mines records contain references to many workings that should be in or near the WSA, but the locations given were generally vague. In some cases, workings matching the described workings were located, but in most cases the described workings could not be matched with workings found during this study.

Present investigation

During the course of the study, the WSA had slightly different boundaries under RARE, RARE II, and Public Law 96-560. To preclude the possibility of an incomplete study should further boundary changes occur, the study covered all ground (excluding the Baca Grant) between the faults that bound the range, and extended at least 1 mi beyond the ends of the boundary.

Prior to field investigations, a background search was made of published literature, Bureau of Mines Files, and files of the Colorado Division of Mines. County courthouse and Bureau of Land Management records were searched for mining claims, oil and gas leases, and geothermal leases.

Mines, prospects, and mineralized areas were mapped and sampled. Samples were taken from structures and mineralized zones exposed at workings or in outcrop. Samples were taken on a grid across the dump, where the working was inaccessible. Most workings examined were discovered during field investigations, and we estimate that 75 to 85 percent of the workings in the WSA were examined. The remainder would be generally below timberline and hidden from aerial view. A few workings were observed at a distance, but time did not allow an examination. An investigation of an area of this size would generally take two or more field seasons, but the report deadline (December, 1983) imposed by Public Law 96-560 precluded two field seasons. To achieve the minimal coverage, sample density was decreased 30-40 percent. Although quantitative evaluation suffered, we do not believe qualitative evaluation would have changed greatly with additional time.

A total of 1,310 samples were taken; all were fire assayed for gold and silver, and spectrographically analyzed for 40 elements. Some samples were analyzed for specific elements by other means: copper, lead, and molybdenum by atomic absorption, tungsten by colorimetry, and uranium by fluorimetry. Complete analytical results are available for public inspection at the Bureau of Mines, Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, Colo. 80225.

Acknowledgements

Special thanks are extended to Jim Brooks and Clyde Matthews of Colorado Fuel and Iron Co.; Chuck Wolfe of the Baca Ranch; personnel at the Great Sand

Dunes National Monument; David C. Scott of the Bureau of Mines; Ray Burney, helicopter pilot; claim owners Bill Humble, Cecil Pickens, Leroy Rusher, George Simmons, and Wright Engineering; and land owners Bill Bunker, Dr. Haller, Henry Lamb, and Walt Weiss.

Mining activity

Mining activity inside the WSA in recent years has been limited to exploration for uranium, molybdenum, copper, and gold. From the late 19th century, mining claims have been staked throughout most of the Sangre de Cristo Mountains. Since most of the old mining claims on record at the courthouses contain vague or misleading locations, only claims currently on file with BLM (as of 1982) are shown on plates 1 and 2. During the 20th century, gold has been produced from various properties along the west side of the WSA, copper production was attempted (with unknown success) near Cotton Creek on the west side of the WSA, and uranium was produced from a few workings scattered through the WSA. No mines with significant recorded production are inside the WSA. The Orient Mine, located outside the western boundary of the area, produced iron ore from 1880-1931. Although there is little recorded production for the Independent Mine, located in the Crestone district outside the western boundary of the area, it reportedly made its two owners millionaires. The Crestone district had several smaller producing mines prior to 1904, when a Supreme Court decision brought about eviction of all miners from the Baca Land Grant (Parker, 1952, p. 27). None of this production is recorded. Production from other properties given in this report, is an estimate derived from Bureau of Mines work on this project.

Records of production are nonexistant for most workings in the Sangre de Cristo Mountains. To give the reader a comprehension of approximate production from workings and mineralized areas, production was estimated from

sample assays and tonnage removed from the ground. These estimates contain two flaws. First, they are inevitably too low, as high grade pockets were generally mined out, leaving only low grade material for sampling. Second, they are an approximation of what was removed from the ground, but recovery of the contained metals may have been poor or nonexistant, at least for some of the metals.

MINING DISTRICTS AND MINERALIZED AREAS

Mining districts

Within the Sangre de Cristo Mountains, in and adjacent to the WSA, are the following mining districts: Blake (Mirage), Blanca, Bushnell Lakes, Cedar Creek, Cloverdale Basin, Cotton Creek, Crestone, Crestone Needles, Hayden Pass, Hermit Pass, Horn Peak, Liberty (Music), Marble Mountain, Orient, Raspberry Creek, Rita Alta (Spruce Creek), San Isabel, South Rock Creek, Steel Canyon, Verde, West Blanca, and Wild Cherry Creek (fig. 2). No boundaries have been defined for any of these districts. Except for references to the part of the Crestone district on the Baca Land Grant, there will be no further mention of districts. Instead, all subdivisions of the area will be on the basis of mineralization and to a minor extent, geology.

Mineralized areas

The Mineralized Areas from north to south are: Raspberry Creek, Bushnell Lakes, Steel Canyon, Cloverdale Basin, Rita Alta copper mine, Orient iron mine, Garner Creek, Cotton Creek, Wild Cherry Creek, Verde Creek, Marshall Gulch, Dimick Gulch, Red beds, Crestone, Liberty, Carbonate Mountain, West Blanca, and Blanca Peak. Locations of the mineralized areas are on figure 3. Details of these areas are on table 1.

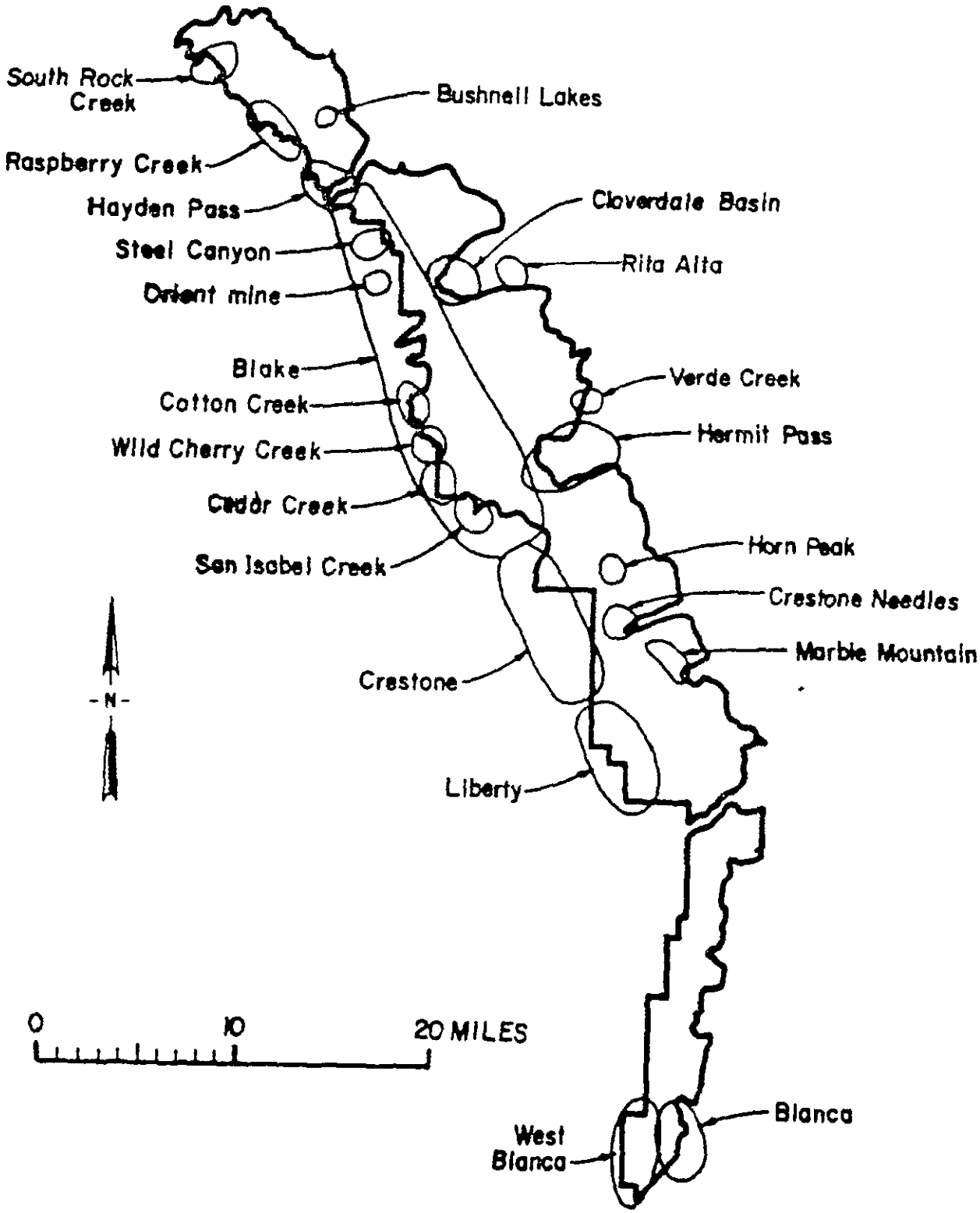

Figure 2.--Map showing locations of mining districts in and around the Sangre de Cristo Wilderness Study Area.

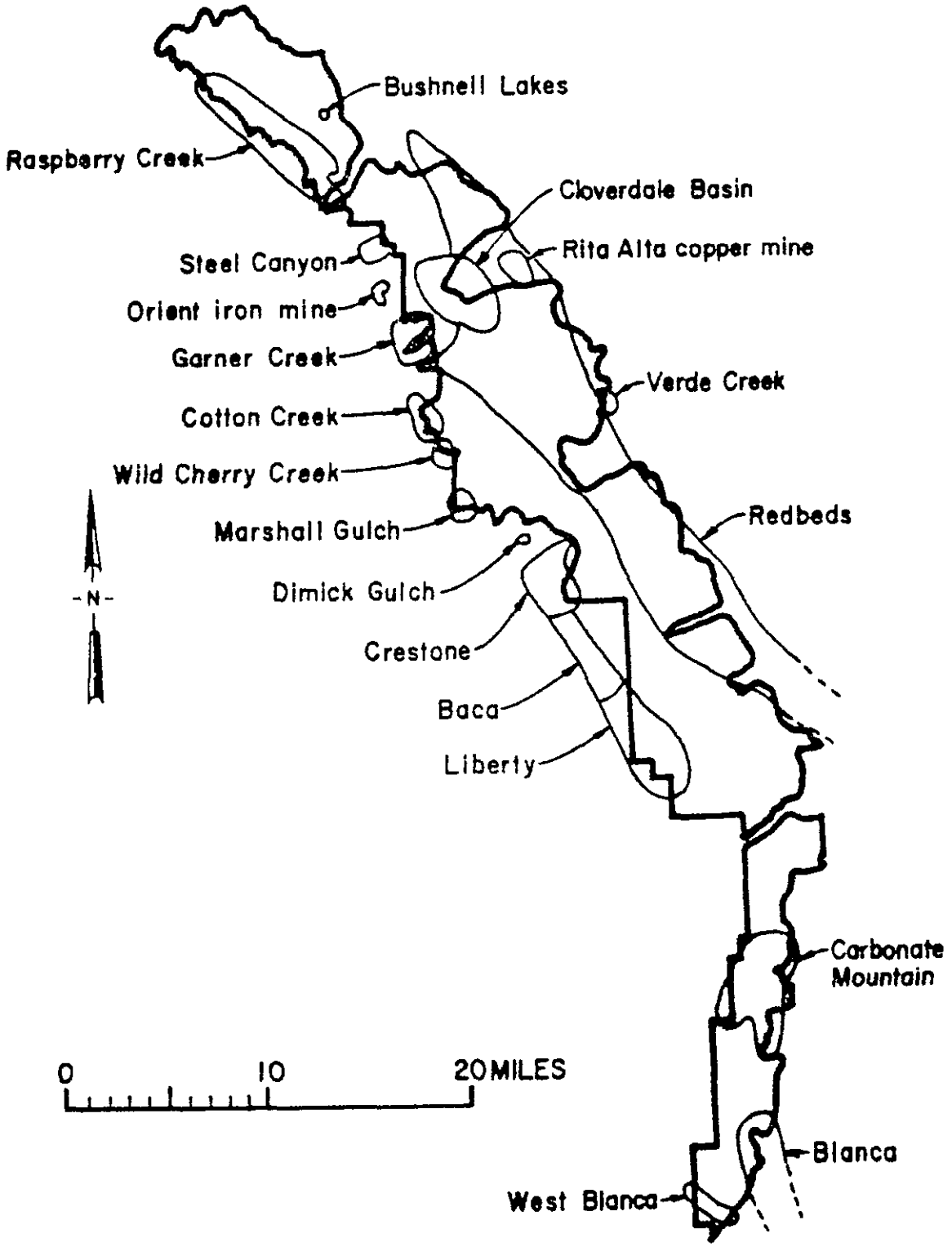

Figure 3.--Map showing locations of mineralized areas in and around the Sangre de Cristo Wilderness Study Area.

Raspberry Creek

The elongate Raspberry Creek area extends along the west side of the WSA from South Rock Creek to Hayden Pass, and from the base to the crest of the Sangre de Cristo Mountains (pl.1).

Precambrian igneous and metamorphic rocks underlie the part of the Raspberry Creek area north of Galena Peak, which is about 1 mi north of Hayden Pass. The lower Paleozoic section, consisting mostly of limestones and dolomites, crosses the crest of the range on the south side of Galena Peak. The Paleozoic rocks dip steeply east and strike nearly north-south.

Small quartz veins, containing galena and chalcopyrite with gold and silver (table 2), have been prospected in Precambrian granite and gneiss from Hayden Pass (fig. 4) to Galena Peak, mostly along the crest of the range. The Paleozoic rocks show no mineralization except for calcite veining and iron staining on Hayden Pass.

The large numbers of caved workings along the base of the range may have been an attempt to intersect the small veins at depth. Mine inspector's reports for 1912 and 1913 mention over 1,400 ft of workings on the Adelaide claims, and three veins containing lead and copper that were followed or intersected. The Adelaide workings were not identified during this study. Except for three dump samples containing gold and silver (table 2, samples 42, 43, 68,) samples from caved workings in the Raspberry Creek area were relatively barren. The rocks along the base of the range, where the caved workings are generally located, are highly fractured because of their close proximity to the Sangre de Cristo fault. Outcrop is very sparse, and in most cases dumps did not show evidence of mineralization or structure except for moderate iron staining. A few dumps had fragments of vuggy quartz with limonite coatings. No resource can be identified in this area, although

opening the many caved workings would provide access to much new information, and might allow one or more small- to medium-size resources of lead, gold, and silver to be defined. Such resources could extend into the WSA.

Bushnell Lakes

Inside of the WSA, on the east side of the range, Paleozoic limestone has been intruded by a small monzonite body. Several prospects (pl. 1) in the limestone show brecciation, baking, and introduction of iron. Assays from these pits (fig. 5) show gold and silver in small quantities; prospects nearer the contact with the monzonite have silicified and serpentinized limestone with sparse chrysotile asbestos.

The exposure is not adequate to identify a resource here, although a small resource or precious metals could exist at depth.

A prospect in faulted limestone further up the Bushnell Lakes trail (pl. 1) was caved, and the dump sample was essentially barren.

Steel Canyon

Steel Canyon is just south of Hayden Pass on the west side of the WSA (pl. 1). Most of the area is in Paleozoic rocks, although Precambrian rocks crop out along the base of the range. The Paleozoic section strikes approximately north, and dips nearly vertically. Cambrian Quartzites overlie Precambrian granite and gneiss at the mouth of the canyon. The lower Paleozoic carbonate rocks are tightly folded parallel to their strike. Pennsylvanian Minturn Formation crops out along the crest of the range.

Workings in the area are adits and a shaft in tightly folded limestone and small marble quarries in locally gently-folded limestone.

Quartz-calcite veins strike about east-west, cutting across the folds. Near the surface, the veins are highly oxidized, leaving a gossan composed of

limonite with minor quartz, calcite, traces of barite, fluorite, and malachite. Where exposed underground, the veins are composed of calcite, limonite, quartz, galena, chalcopyrite, and fluorite. Assays of samples show silver, occasionally gold, and traces of zinc and antimony (table 3; figs. 6-8).

The major veins are exposed in two adits about 1/2 mi apart (figs. 6, 7), and one caved adit in between explored a gossan on the trend. A fourth working on this trend was seen from the air, but never found on the ground because the vein(s) crop out in dense timber on a north-facing slope. Quartz vein material containing silver (table 3) is on the dump of a prospect in Precambrian granite near the western adit. This could be a parallel vein. About 1/2 mi outside the WSA, near the ridge top, are two shafts on smaller veins of similar orientation (fig. 8).

The vein system could be related to a rhyolite dike that crops out on the ridge at the head of Steel Canyon, although there is no evidence of veining in the Minturn Formation sandstones and shales which are between the dike and the vein exposures. The dike is an offshoot of the Tertiary Rito Alto stock, and is inside the WSA.

A large mill building was standing in Steel Canyon in 1982. According to claim owner George Simmons (oral communication, 1982) the mill operated briefly in about 1901. The only remaining equipment is a boiler.

About a third of the workings that were active in 1902 to 1904, according to mine inspector reports, were not found during this study. The Mountain Lion Mine, largest recorded lead producer in the Sangre de Cristo Mountains, is located just north of Steel Canyon according to Bureau of Mines production records. No workings were found during this investigation which could have yielded the tonnage attributed to the Mountain Lion; however, the relative quantities of metals in veins in Steel Canyon, and the fact that at least one

large working was seen only from the air, suggest that the Mountain Lion is in the Steel Canyon area.

The estimated metal production from Steel Canyon was 5 oz of gold, 7,000 oz of silver, 70,000 lb of lead, and 8,000 lb of copper.

A small silver-lead resource is present in Steel Canyon, outside the WSA. The silver-lead vein(s) could extend into the WSA.

Cloverdale Basin

Cloverdale Basin is partly in an embayment into the eastern side of the WSA. The Tertiary Rito Alto stock crops out in the basin and along the crest of the range within the WSA. The Rito Alto stock is a composite granitic pluton that intrudes the Sangre de Cristo and Minturn Formations. Contacts of the stock with the surrounding Sangre de Cristo and Minturn Formations are: 1) faults with minor alteration, and 2) intrusive contacts with intense but local thermal alteration and remobilization of iron.

The stock was prospected for molybdenum both recently, by Molycorp, and before 1918 (Worcester, 1918, p. 52-53). The molybdenite occurrence is associated with quartz veins and a rhyolite dike within the stock, although many other samples from other parts of the stock contain trace amounts of molybdenum and copper (table 4). Gold, silver, and tungsten were also found in assays of samples from prospects in the Rito Alto stock.

The Stamina (Cloverdale) Mine, in the basin, was driven about 1,600 ft between 1922 and 1950 (fig. 9). The target of the effort was a copper-bearing vein in the Minturn Formation. A few ounces of gold may have been produced in 1931, but the copper-bearing vein was not intersected. The vein outcrop was not found in the limited time of the study.

No resource was identified within the immediate area of outcrop of the

Rita Alta copper mine

The Rita Alta Mine is about 1/2 mi outside the eastern boundary of the WSA (pl. 1). The mineralized area is in sandstone and siltstone of the Pennsylvanian-Permian Sangre de Cristo Formation, between two faults that parallel the base of the range. Veins of barite, quartz, and charcopyrite along bedding planes and joints are exposed in an open cut.

Underground workings were not accessible, but development would have been at least a few thousand feet according to dump size.

The mine produced copper, silver, and gold in the early 1900's. The mineralization could be related to the faults or the Rito Alto stock about 2 mi to the west. A small copper resource could extend into the WSA.

In the mid 1950's, tantalum was believed discovered in the 3,200 ft Peerless Tunnel (fig. 10) about 1/2 mi south of the Rita Alta Mine. An investigation, including sampling, by the Bureau of Mines and the Geological Survey (Harshman, E. N., and Salsbury, M. H., 1954, DMEA Report 3236, Bureau of Mines files, Denver, Colo.) resulted in the conclusion that no tantalum or columbium was present. The examiners concluded that the analyses that reported tantalum were faulty because tantalum determinations were difficult and false results common.

Orient iron mine

The Orient Mine is outside the western edge of the WSA (pl. 1). Between 1881 and 1931 the mine produced 1.7 million tons of iron ore (Stone, 1934, p. 317) from an oxidized replacement deposit in sheared Leadville Limestone, adjacent to the Sangre de Cristo fault. According to Stone, the ore was limonite after siderite, however, the possibility exists that the Orient deposit is a gossan over a sulfide deposit. Bureau sampling in the Orient

was done to compare minor elements with those in other gossans. The comparisons were inconclusive, and Orient Mine sample analyses are not presented here at the request of Colorado Fuel and Iron Steel Company. The Orient was originally a copper prospect, and sparse chalcopyrite and barite occur throughout the ore body. Gold was reported in some assays (Stone, 1934, p. 325).

Stone's work identified reserves below the main (5th) level. A sixth level was started, but was never advanced to the remaining ore. This resource is outside the WSA, and does not continue along strike into the WSA, because the Leadville Limestone is cut off by a fault just north of the mine. The Sangre de Cristo fault is a convenient source for the mineralizing fluids, however, the mineral assemblage (barite and chalcopyrite) is the same as the Rita Alta Mine and elsewhere around the Rito Alto stock. The fault or the stock could be the source of mineralizing fluids. Most of the area between the stock and the Orient Mine is within the WSA.

Garner Creek

Approximately one quarter of the Garner Creek area, just south of the Orient Mine, is in the WSA (pl. 1). The area is composed of small fault blocks of Precambrian and Paleozoic rocks.

Hot Springs Canyon, the north part of the area, is in Precambrian granodiorite. Two short adits explore a small quartz vein with sparse chalcopyrite (fig. 11). Near the mouth of the canyon a third adit explores a barite vein with minor chalcopyrite in the Minturn Formation sandstone (fig. 12).

Garner Canyon, in the middle of the area (fig. 13A), has a number of small workings in Precambrian granite and quartzite, and Minturn Formation shale

and sandstone. A fracture zone in quartzite exposed in an adit (fig. 13B), has fillings of limonite, and chalcopyrite. Some wall rock replacement is evident. Assays show minor silver content in this material. The Rito Alto stock contact-zone is exposed in prospects not far up the canyon. Copper, cobalt, molybdenum and barite are present in most of the samples from Garner Canyon (table 5, figs. 13A, B).

Major Canyon, south of Garner Canyon, has two short adits (fig. 14) on a brecciated contact between lower Paleozoic limestone and quartzite. Limonite has replaced some of the limestone. This is considered an iron prospect because: 1) iron content averaged 51 percent, and 2) gold content averaged 0.094 oz/ton--more than adequate reason for more extensive workings. Although about 50 oz of gold came from the small workings, none may have been recovered.

A small gold resource is identified in Major Canyon along a contact that is not present in the WSA (about 1,500 tons of 0.10 oz/ton gold), and a small copper resource may be present in Garner Canyon, outside of, but possibly extending into the WSA.

Cotton Creek

Cotton Creek is just south of Major Creek on the west side of the Sangre de Cristo Wilderness Study Area (pl. 1). Over half of the mineralized area is in the WSA.

Chalcopyrite is found disseminated in Precambrian gneiss and granite, along foliation planes in gneiss, in quartz veins, and in quartz-barite veins from Cotton Creek nearly to Wild Cherry Creek (table 6). The most intense mineralization is between Cotton Creek and Spring Creek (figs. 15A-C, 16A-C).

Adits, open cuts, pits, and drill holes were used to explore the deposit. Mining attempts date from about 1900 to the mid 1960's. Inspiration

Consolidated Copper Co. claimed much of the area in 1977. Leaching was attempted in 1929, and smelting on site in 1958. There are no records to indicate either was successful. Road maintenance was observed in 1982, but no exploration or development work.

The barite-chalcopyrite mineralization suggests a possible relationship to mineralization at the Orient and Rita Alta Mines, and in Garner Canyon. Silver and gold are present in some samples (figs. 15A, B, C, 16A, B, C, and tables 6, 7). The deposit could be related to either the adjacent Sangre de Cristo fault or the Rito Alto stock, or have been influenced by both.

Estimated production was about 300 oz of gold, 2,000 oz of silver, and 300,000 lb of copper.

An indicated resource of 3,700 tons of 0.09 oz/ton gold, 0.17 oz/ton silver, and 0.86 percent copper is present in the WSA. An indicated resource of 90,000 tons of 0.007 oz/ton gold, 0.06 oz/ton silver, and 0.55 percent copper is at least half inside the WSA.

Wild Cherry Creek

On the west side of the WSA, south of Cotton Creek, the Precambrian gneiss and granite is cut by quartz veins and faults trending N. 10° W. to N. 20° E. Seven adits explore these structures (pl. 1; fig. 17A).

On the north side of Wild Cherry Creek, two narrow, parallel N. 20° E.-trending quartz veins containing galena and sparse chalcopyrite are explored by two adits and a 30-ft shaft (fig. 17B). Both veins contain silver averaging 0.6 oz/ton. A lower adit that should have cross cut to both veins is caved. All other structures in the area are almost barren (figs. 17A, C-F, table 8).

Estimated production from these veins was about 100 oz of silver, 6,000 lb of lead, and 500 lb of copper.

A very small silver-lead resource is identified in the WSA at the two northern adits on Wild Cherry Creek: 1,400 tons averaging 0.032 oz/ton silver, 0.78 percent lead, and 0.06 percent copper.

Verde Creek

The Verde Creek area is outside the eastern boundary of the WSA (pl. 1). Precambrian granite is faulted against the Sangre de Cristo Formation, and the granite is the host for most of the mineralization. Quartz veins contain chalcopyrite, and minor galena and barite. Vein trends are unknown because outcrops are sparse and all workings are caved (fig. 18).

The larger workings all were started in granite, but sandstone on some dumps indicates that those workings crossed the fault and penetrated the sandstone. Only a few prospects were started in sandstone (table 9, samples 690, 691, 701, 703), and while not barren, did not expose mineralization as rich as that found in the granite. Assays show silver in about half the samples and gold in a few (table 9).

The area was prospected in the early 1880's and at least one property had production prior to 1901. Unless the deposit(s) was competely mined out, a silver-copper resource is present, but cannot be shown to extend into the WSA.

Marshall Gulch

On the west side of the WSA, south of Cedar Creek, shallow workings explore shear zones and quartz veins in Precambrian granite inside the WSA (fig. 19A). The structures trend north-northwest, parallel to the Sangre de Cristo fault.

Gold, silver, and copper are present in some samples--enough to encourage prospecting. Approximately half of the samples are barren (figs. 19A, B). No resource was identified in the Marshall Gulch area.

Dimick Gulch

The Dimick Gulch area is on the west side of the WSA, south of San Isabel Creek (pl. 1). Along Dimick Gulch, shallow workings (fig. 20A) explore a gossan zone in lower Paleozoic limestones and quartzites overlying Precambrian granite on a possible thrust fault. Trace amounts of silver, gold, cobalt, arsenic, molybdenum, and lead were found in many samples from Dimick Gulch (table 10, figs. 20A-C).

No resource was identified in the Dimick Gulch area.

North of San Isabel Creek there are extensive, but caved and possibly barren adits. Several workings mentioned in the Colorado Division of Mines files were not found. One mile farther northwest are a number of workings on pegmatites. Data for these samples are on miscellaneous table 28.

Red beds

The red beds uranium-copper area is mostly in the WSA, in the central part of the Sangre de Cristo range (pl. 1). The red beds are the Pennsylvanian Minturn and Pennsylvanian-Permian Sangre de Cristo Formations which extend along the crest of the range from Music Pass on the south, almost to Hayden Pass on the north.

Uranium is localized in gray siltstones near the top of the Minturn. The stratigraphic unit is continuous, but the mineralization is spotty and weak. Few prospects gave scintillometer readings over 200 counts per second (against a background of 40-60 counts per second). Sixty-seven samples were analyzed for uranium; only eight contained over 100 ppm U_3O_8 (table 11). The

major producer was near South Colony Lakes (fig. 21). About 170 lb of U_3O_8 was produced in 1958 and 1959.

Copper is found in both the Sangre de Cristo and Minturn beds. Occurrences are scattered, and contain malachite staining and rare chalcopyrite near faults (figs. 22, 23), and small barite veins with sparse chalcopyrite. The Hermit Pass Mine (fig. 23) was an unsuccessful attempt to mine a low-grade (table 12) deposit by underground methods in about 1900.

Although both uranium and copper are widely distributed in the two formations in the WSA, the occurrences are too small and low grade (tables 11, 12, figs. 21-23) to be resources.

Crestone

The Crestone gold-silver area is midway along the west side of the WSA (pl. 1). It is the northern end of the Crestone mining district, and is immediately east of the small town of Crestone. The southern 2/3 of the district is on the privately owned Baca Land Grant.

Steeply dipping quartz veins containing limonite and pyrite strike north to northwest through Precambrian granite (figs. 24A-E), roughly paralleling the Sangre de Cristo Fault. In the accessible workings, the veins would persist at most, a few hundred feet. Ore shoots within the veins were generally small.

North of the Baca Grant, in the Crestone district, a dozen mines reportedly shipped ore. Because of poor access, few of the workings could be positively identified. In 1979, all three mines in Pelican Gulch (informal name for canyon just south of Burnt Gulch) were caved (fig. 24A, table 13). In early 1982 one adit had been re-opened (fig. 24D), and was partly examined, but heavy rain caused the portal to again cave before the stoped area could

be examined. Most of the Sunbeam Mine(?) was examined (figs. 24E, F, table 14), although hip waders were required in the first 120 ft. At least four possible vein intersections in the Burnt Gulch-Pelican Gulch vicinity have not been explored.

Several workings in the Crestone area are essentially barren (figs. 24G, 25-28). Only one of the structures examined in North Crestone Creek (figs. 25-28) showed any consistant mineralization (fig. 25, tables 15, 16). No workings were found accessible in South Crestone Creek, but a dump sample from one caved adit (table 13, sample 577, fig. 24A) had good gold and silver values. Prospects between South Crestone Creek and Willow Creek (figs. 24A, G) yielded samples containing gold, silver, and copper.

Oxidized quartz veins were first worked by Spanish explorers (Parker, 1952, p. 25). The Crestone district boomed during the 1880's and 1890's, but a U.S. Supreme Court decision granted all mineral rights to the owners of the Baca Land Grant, and by 1904 the miners were removed (Parker, 1952, p. 27). The northern part of the district, around the town of Crestone (fig. 24A), was not as rich, and mining activity declined rapidly after 1904.

Production from the Crestone district outside of the Baca Land Grant was at least 300 oz of gold and 400 oz of silver. A small to medium-size goldsilver resource remains, mostly in unoxidized veins that could not be profitably milled in the 1880's and 1890's. In the 1930's the cyanide process was successfully used to extract gold from these veins (Parker, 1952, p. 43), but World War II curtailed the operation. It was never resumed. No part of the identifiable resource is in, or extends into the WSA.

Liberty

The Liberty area is on the west edge of the WSA, on the southeast edge of the Baca Land Grant, and on the north edge of the Great Sand Dunes National

Monument (pl. 2). Country rocks are Precambrian gneisses, granites, and a thin sliver of Paleozoic sedimentary rocks. Northeast to northwest trending faults and quartz veins roughly paralleling the Sangre de Cristo fault are the mineralized structures except at a working (fig. 29) near the edge of the Baca Land Grant, which may be a disseminated gold deposit.

Most workings in the area are in Pole Canyon (figs. 30A-I) or on Short Creek above the ghost town of Liberty (figs. 31A-D), however the largest working is in the WSA on Sand Creek about 2 mi east of Liberty. About 1 1/2 mi farther southeast near Cold Creek (pl. 2), hematite-quartz filled breccia zones were prospected.

The mine in Sand Creek was caved, as were the workings on Milwaukee Hill (fig. 30A). Examination of the other workings (figs. 30A-I, 31A-D, tables 17, 18, 19, 20, 21) showed discontinuous veins which once contained a few high-grade pockets of ore. Galena, chalcopyrite, and sphalerite are present in one vein in Pole Canyon (fig. 30A and table 17).

The main mining activity in the Liberty area was between 1889 and 1904 (Parker, 1982, p. 27). Mill and tramway remains are present in Pole Canyon, Sand Creek, and Short Creek.

Estimated production from the Liberty mineralized area was at least 150 oz of gold and 1,000 oz of silver. A small gold-silver resource may be present in Pole Canyon, inside the WSA; however, additonal work is needed to confirm or disprove the possibility.

Carbonate Mountain

The Carbonate Mountain area is mostly inside the WSA south of Mosca Pass and southeast of the Great Sand Dunes National Monument (pl. 2).

Prospecting was extensive in Morris and Evans Gulches, adjacent to the National Monument. The rocks here are a contorted mass of metamorphosed sediments, probably Minturn Formation and older igneous and metamorphic rocks. Copper, gold, and silver minerals are locally present (fig. 32, table 22), but their relationship to structure or rock type is not apparent because of poor exposures.

The crest of the range, from Mosca Pass south for 7 mi, was extensively prospected (pl. 2). Three caved adits are on the east side of the ridge south of Carbonate Mountain. Accessible prospects are on northwest-trending quartz veins in Precambrian gneiss and granite. Gold, silver, copper, and lead are shown in some assays (table 22).

There are several shallow adits in Precambrian gneiss and granite near the mouth of North Arrastre Creek (figs. 33A-C). Chalcopyrite is present in a decline that explores a thrust fault on the north side of the canyon (fig. 33B). Samples from this fault and from four dumps across the canyon contain small amounts of gold. No definite relationship can be established between the various workings because the adits on the south side of the canyon were caved and outcrop on the south side of the canyon was lacking.

A small gold resource may exist in the WSA at North Arrastre Creek, but there is insufficient evidence to identify a resource at this time.

Blanca Peak

On the southeast end of the WSA, a N. 30° W.-trending quartz vein cuts Precambrian granodiorite and gneiss at Blanca Peak, and is exposed for about 2 1/2 mi along strike (fig. 34A). The vein enters the WSA, but is hidden under talus and its extent within the WSA is unknown. A northern branch of the vein probably enters the WSA also. The vein and its main branch (fig. 34A)

have over 3,000 ft of development (figs. 34B-E). Gold and silver are present in almost every sample, and average 0.1 oz gold per ton and 2 oz silver per ton across an average 4 ft mining width (tables 23, 24, 25). Scheelite is visible in shoots unrelated to gold and silver distribution. Gold is associated with pyrite. Silver is present in a red-gray mineral.

Platinum has been reported in assays from the veins (Wright Engineering, written communication, Nov. 13, 1981). Platinum assays are difficult, and often erroneous. No platinum was detected in any of the 11 samples analyzed for platinum in this study. The country rock is granodiorite cut by mafic dikes. Near the veins, the rock is too sheared and chloritized to determine which rock type is locally present. Lenses of gabbro and pyroxinite are present in the granodiorite mass, some containing a few percent sulfide minerals (pyrite and chalcopyrite). Platinum would not be out of place in the ultramafic rocks, but mining would be impractical because the lenses are small and scattered. It is possible that some byproduct platinum might be recovered if the veins were mined.

The veins crop out at elevations between about 11,600 ft and 13,800 ft. Mines are at 11,600, 12,300, and 13,000 ft. Prospects are as high as 13,200 ft. The two major workings--on the Eagle Plume and Dividend claims--have their portals low on the north face of Blanca Peak. Both portals are in, or adjacent to, gullys that are also avalanche chutes. Most years the portals are not visible until mid-August when the avalanche snow has melted. Mine managers reports are available for only 1900 and 1901. The reports claim about 1,600 ft of development in this time period--an impressive rate of advance--from 120 ft to 1,700 ft. The mine (both adits) has about 2,300 ft

of development. The mine had a tram to a mill about 1/2 mi below, in the valley. The upper tram station has been thoroughly mangled by avalanches. A cross-cut adit was begun in a relatively avalanche free site, about 1,800 ft from the veins, but was only driven about 200 ft. About 20 cords of cut wood for boilers at mine and mill are scattered around the basin. Exactly when it became clear that the avalanche problem could not be successfully dealt with is unknown.

The only recorded production from the area was about 40 oz of gold. The estimated production of gold was 400 oz. The ore was not oxidized and would have required cyanide processing for good recovery. About 7,000 oz of silver was removed from the ground, and some may have been recovered. Over 1,000 short ton units of tungsten were removed from the ground, but there is no reason to believe any was recovered. This estimate of production includes the workings above Winchell Lakes (fig. 35). One adit (fig. 34F) north of Blanca Peak was barren.

Quartz veins on the south side of Blanca Peak and a breccia pipe northeast of Blanca Peak (pl. 2; table 26) contain the same minerals as the major vein. Veins west of Blanca Peak (fig. 36; table 26) are relatively barren.

A medium-size gold-silver-tungsten resource (table 1) is present outside the WSA, and extends some distance into the WSA.

West Blanca

The West Blanca area is inside the WSA on its south end (pl. 2). Workings explore northerly-trending quartz veins and irregular altered zones in Precambrian granodiorite, granite, gneiss and schist (figs. 37-39). A few

samples contained gold and silver, and several showed copper, cobalt, molybdenum, and bismuth (figs. 37-39, table 27). An area below Como Lake on Holbrook Creek appears to have been hydraulically worked for placer gold.

The Swab Mine (fig. 38) in the south end of the WSA, followed a 30° E. dipping, northeast-trending fault for about 120 ft. Copper-gold mineralization was present at the portal, but disappeared within about 40 ft. A tramway extends from the mine to the base of the range. Debris found at the camp between mine and tram base indicate the operation took place in the late 1920's to early 1930's.

The Commodore, Little Bear, Homestake, and Calumet Mines, listed as being in the district around 1900, were not found.

No resource was identified in this area.

Miscellaneous resources

Precambrian pegmatites scattered along the west side of the Sangre de Cristo range have been worked for uranium (Nelson-Moore and others, 1978, p. 389-393), feldspar, and beryl; a little manganese was produced from a fault in Rito Alto Creek; decorative quartz was quarried from a vein near Crestone; one prospect adit near Liberty showed traces of copper and molybdenum (fig. 40); and veins near Liberty were worked for fluorite. All of these occurrences are localized, and no resource related to any of them could be identified in the WSA.

East of the WSA, at Coaldale, gypsum is being mined from Minturn Formation horizons which are not known to exist in the WSA.

Limestone has been quarried on the northeast side of the WSA for use in sugar beet refineries and Colorado Fuel and Iron Corporation's steel mill (Argall, 1949, p. 262). The limestone crops out from Hayden Pass to the Arkansas River. Much of the outcrop is in the WSA, and many claims were

staked for limestone near Hayden Pass, however substantial amounts are available near the Arkansas River where there is highway and railroad access.

Bentonite was being mined north of the WSA in 1979. The mines were idle in 1982. The bentonite is in a Tertiary volcanic unit not present in the WSA.

A small quarry near the bentonite mines yielded building stone from a rhyolite tuff of very local extent. Decorative marble was quarried and shipped from Steel Canyon in small quantities according to Argall (1949). Pink, yellow, black, blue, and green marble are mentioned. The pink marble is an iron stained sandstone. The yellow marble is buff, fine-grained marble, too tightly broken by bedding and joints to yield blocks larger than about 2 ft on a side. No black, blue, or green quarries were found, although much of the limestone might be described as blue. The marble does not extend into the WSA.

Prior to establishment of the Great Sand Dunes National Monument, the dunes were placered for gold. Part of the gold was in magnetite and not readily recoverable (Siebenthal, 1910, p. 48).

Most samples taken outside mineralized areas were relatively barren or showed weak and spotty mineralization (table 28).

The Sangre de Cristo fault which bounds the Sangre de Cristo Mountains on the west is a component of the Rio Grande Rift. Hot springs are not uncommon along the rift. Valley View Hot Springs, just south of the Orient Mine is the only known hot spring along the Sangre de Cristo fault. Two Known Geothermal Resource Areas are within 2 mi of the WSA. As of November 1982, there were ten geothermal leases and four geothermal lease applications within 2 mi of the WSA boundary (fig. 41). Geothermal lease applications in the WSA total 750 acres.

As of November 1982, there were ten oil and gas leases and nine oil and gas lease applications within 2 mi of the WSA boundary (fig. 42). Inside the WSA, 60 acres were leased for oil and gas, and 10,600 acres were under oil and gas lease application.

CONCLUSIONS

A north-northwest trending zone of mineralized terrane parallels the still active Sangre de Cristo fault north of the Great Sand Dunes National Monument. Where the fault bends more nearly north-south, in the area of the dunes, the zone of mineralized veins and faults continues south-southeast through Blanca Peak. Figure 3 shows gaps in this zone which may be real or merely a lack of information. The structures along this trend are associated with all but three of the structurally-related mineralized areas in the Sangre de Cristo WSA.

North of the sand dunes, Precambrian rocks have been faulted against Pennsylvanian-Permian rocks. Subsequent movement along the Sangre de Cristo fault caused the fractures which were later filled with ore mineral-bearing quartz veins. The age of mineralization is considered Laramide to Tertiary.

The Tertiary Rito Alto stock contains molybdenum-copper-gold-tungsten mineralization, and has a possible relationship with six other mineralized areas. All six of these areas are in the vicinity of one of the two faults bounding the Sangre de Cristo range. It is unclear whether the faults or the stock, or both are genetically related to these mineralized areas. A few productive veins in these areas have trends which do not relate to movement along the Sangre de Cristo or Alvarado faults.

Precious metal, base metal, and tungsten resources exist along the north-northwest trending mineralized zone. From Blanca Peak to Arrastre Creek,

deposits contain gold, silver, and tungsten. Between Arrastre Creek and Pole Canyon, the deposits contain gold, silver, and minor amounts of base metals. Deposits between Pole Canyon and Crestone contain gold and silver. From Crestone to Wild Cherry Creek deposits contain gold and silver, but in lower concentrations. From Wild Cherry Creek to Cotton Creek the deposits grade from silver-lead with minor copper to copper with gold and silver. This appears to be zoning away from the Cotton Creek copper deposit. From Cotton Creek to just north of the Orient Mine, the deposits contain copper, gold, silver, and iron. Deposits between the Orient Mine and Galena Peak contain lead and silver with minor amounts of copper and gold.

Around the Rito Alto stock, deposits contain copper, gold, barite, and iron. Molybdenum deposit(s) may be related to the stock, but this has not yet been established.

Resources within the area were identified at Cotton Creek (copper-gold-silver), Wild Cherry Creek (silver-lead), Liberty (gold, silver), and Blanca Peak (gold-silver-tungsten). Resources identified at Steel Canyon (silver-lead), Rita Alta Mine (copper), and Crestone (gold-silver) cannot, at this time, be shown to extend into the WSA.

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MINERAL INVESTIGATION OF THE LOST CREEK WILDERNESS, PARK AND JEFFERSON COUNTIES, COLORADO

By Clarence E. Ellis, Bureau of Mines

INTRODUCTION

The Bureau of Mines conducted a mineral investigation of the Lost Creek Wilderness, as part of a joint effort with the Geological Survey, to evaluate the mineral resources of the area (fig. 1). Courthouse and Bureau of Land Management records were searched during the spring of 1980 for mining claim locations. Bureau of Mines personnel Clarence E. Ellis, David C. Scott, Alan M. Bielski, David R. Goddard, and Richard E. Gertsch began field work in Lost Creek in the summer of 1980. Field work was completed by Ellis and Scott in June 1981.

Field studies included an examination of mines, prospects, and mineralized areas (pl. 1). Structures or mineralization at the workings examined were sampled. Samples were taken on a grid across the dump where workings were inaccessible. Panned-concentrate samples were taken from stream sediments of major drainages. All 172 samples taken were fire assayed for gold and silver, and spectrographically analyzed for 34 elements. Seventy-four samples were analyzed for beryllium by atomic absorption. Specific analyses were done for molybdenum, tungsten, uranium, and fluorite where they were observed or where they were indicated by the spectrographic analysis. Results of all sample analyses are available for public inspection at the Bureau of Mines, Intermountain Field Operations Center, Denver, Colo. 80225.

Location, size, and geographic setting

The Lost Creek Wilderness was created from two RARE II areas. The 58,040-acre Lost Creek RARE II Further Planning Area and 71,000-acre Lost Creek RARE II Wilderness Recommendation Area were designated by the Forest Service in its Second Roadless Area Review and Evaluation, January 1979

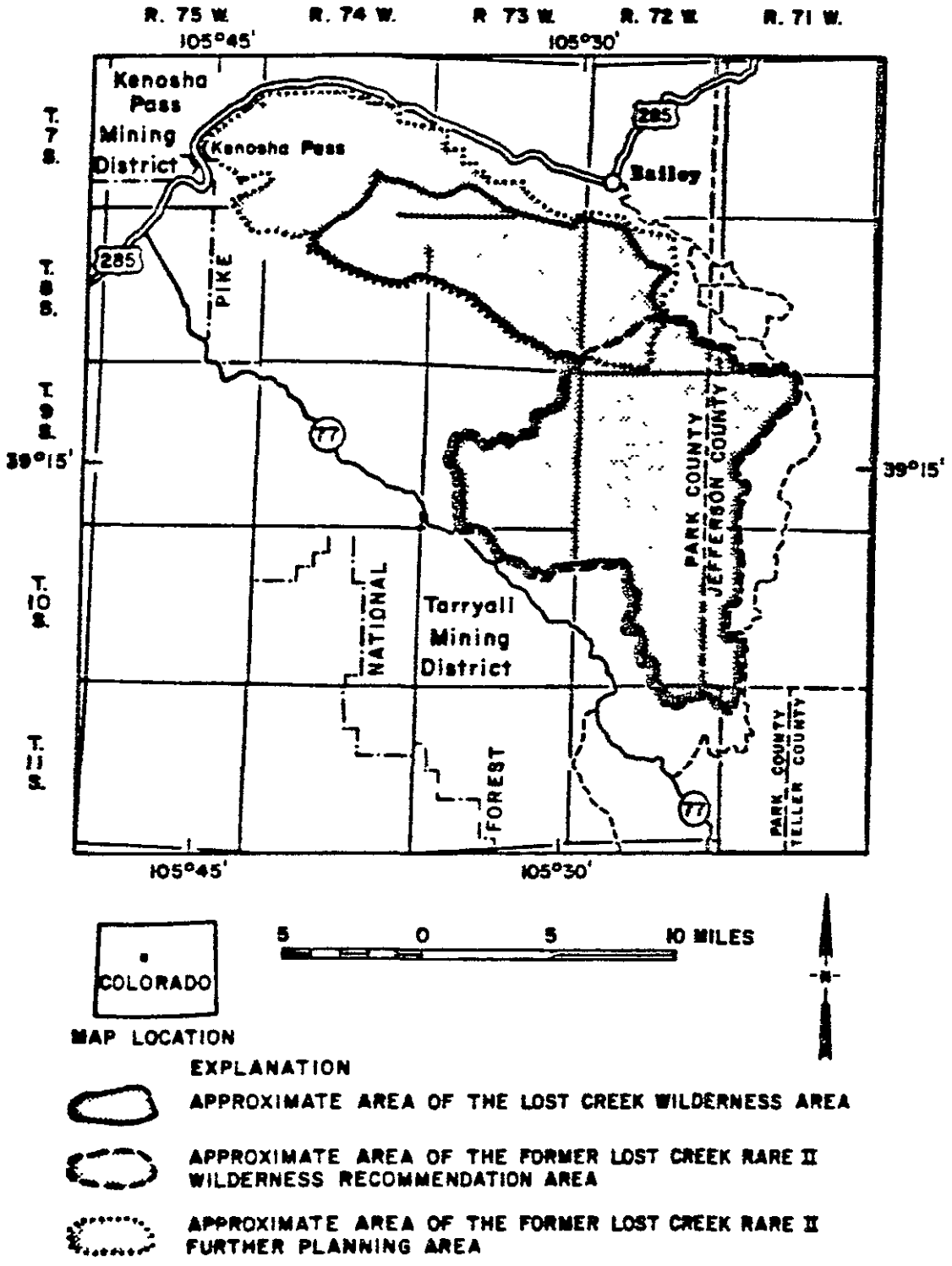


Figure 1.--Index map of the Lost Creek Wilderness and RARE II Areas.

(fig. 1). Both RARE II areas are in the Pike National Forest. The further planning area is adjacent to and northwest of the wilderness recommendation area, and entirely in Park County, central Colorado. The wilderness recommendation area is in Park County except for a small part that is in Jefferson County. The Colorado Wilderness Bill (Public Law 96-560, December 22, 1980) deleted the northwest end of the further planning area while creating the approximately 106,000-acre Lost Creek Wilderness from the combined RARE II areas.

The northeast part of the wilderness is located about 1 mi southwest of the town of Bailey and 26 mi southwest of Littleton, a suburb adjacent to the southern city limits of Denver. U.S. Highway 285 on the northeast, Colorado Highway 77 and Forest Service roads on the southwest, and Forest Service roads on the east bound the wilderness (fig. 1).

Within the northwest-trending wilderness area are the Platte River Mountains, Kenosha Mountains, and the southeast end of the Tarryall Mountains (pl. 1). In general, elevations in the Platte River Mountains decrease from northwest to southeast and are slightly higher than 12,000 ft. The highest point in the wilderness is 12,431-ft Bison Peak in the Tarryall Mountains. The north and west parts of the wilderness are, primarily, steep slopes forested up to timberline (about 11,500 ft elevation). Above timberline the terrain is rolling and tundra covered. The southeast part of the wilderness is mostly exposed rock, in the form of pinnacles and gigantic boulders, and scattered stands of timber.

The Kenosha Mountains and Tarryall Mountains are separated by a creek bearing two names: the upper end, called Lost Creek, goes underground beneath giant boulders in the center of the wilderness; where it reappears, the creek is called Goose Creek.

Geologic setting

The following brief description of the Lost Creek Wilderness Area geology is based on published work and field observations and is included to facilitate understanding of this report. Additional information, developed by the Geological Survey during its part of this investigation, will add to or change this preliminary description.

Rocks of the Lost Creek Wilderness are Precambrian in age, and have been identified as Idaho Springs Formation, Boulder Creek Granodiorite, and Silver Plume (Gallagher, 1976, p. 4), Pikes Peak, and Redskin Granites (Hawley, 1969, p. A4) (fig. 2).

The metamorphic Idaho Springs Formation, the oldest rocks of the area, is present on the north, west, and south sides of the wilderness. It is composed of gneiss, with lesser amounts of pegmatite and amphibolite. Boulder Creek Granodiorite (Precambrian X) and Silver Plume Granite (Precambrian Y) intrude the Idaho Springs Formation in the western part of the wilderness (Gallagher, 1976; Tweto, 1979). The intrusive rocks form the high, central ridges of the Platte River Mountains. These two intrusive units were not differentiated in the field.

Pikes Peak Granite (Precambrian Y) covers more than half the wilderness and extends eastward beyond its boundaries. The coarse-grained pink Pikes Peak Granite forms the pinnacles, domes, and arches in the southeastern third of the wilderness. It is younger than the Silver Plume (Hawley, 1969, p. A4) and probably intrusive into it, although the contact was not observed.

The Redskin stock, the youngest rock of the area, is a fine-grained pink granite that intrudes the Pikes Peak Granite on the southern edge of the area. Hawley (1969, p. A5) mapped its boundaries during his studies of beryllium mineralization in the Tarryall district.

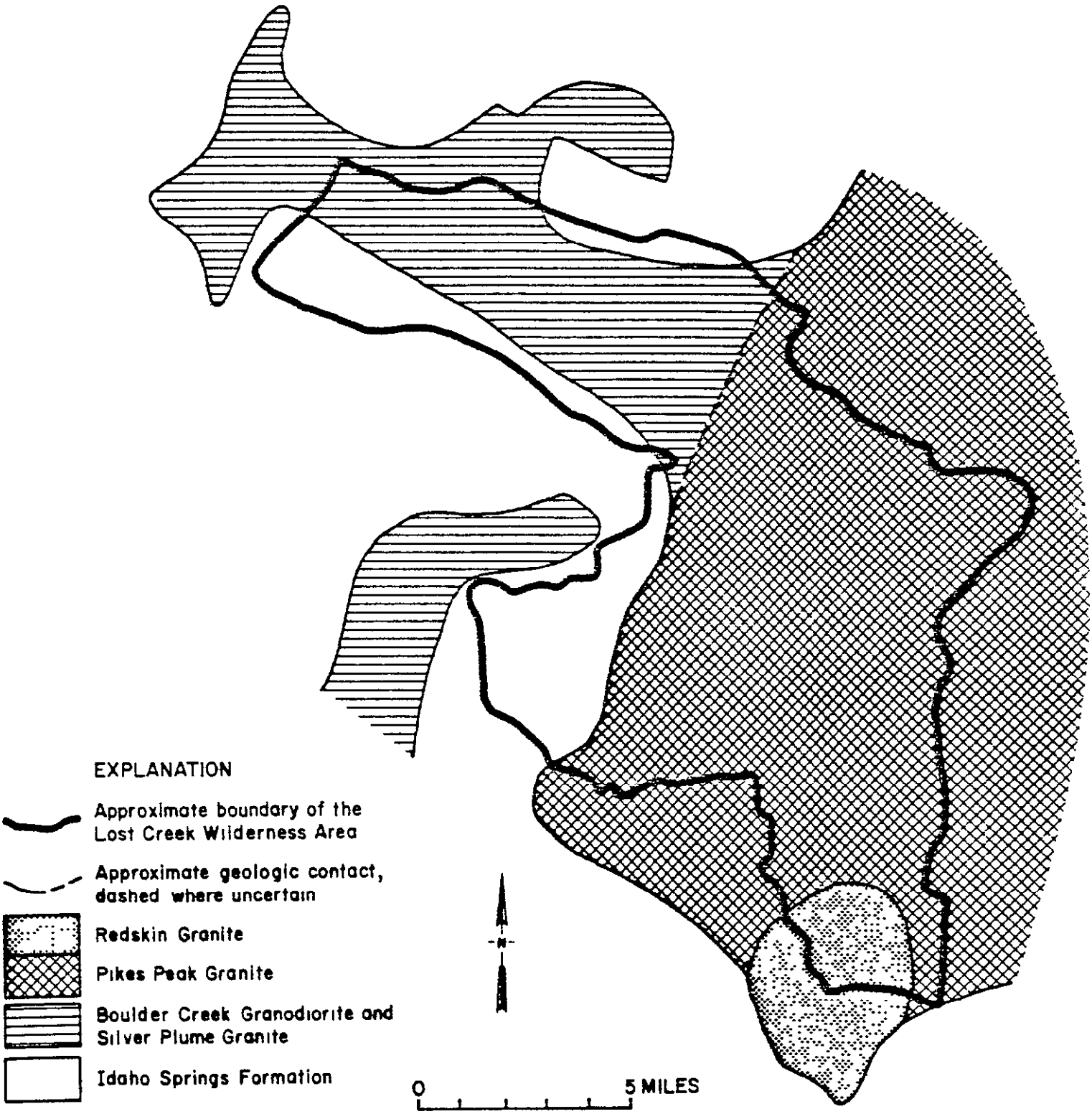


Figure 2.--Generalized geologic map of the Lost Creek Wilderness, modified from Tweto (1979) and Hawley (1969).

A northwest-trending Precambrian set of faults control the topography of the western half of the wilderness (Tweto, 1979). In the Tarryall district, a northeast-trending set, also originating in the Precambrian, is present. Both sets are locally mineralized (Hawley, 1969, p. A7).

Mining activity

Except for mineral collecting, there is no evidence of any mineral production within the wilderness. Evidence of even prospecting in the wilderness is very slight.

A small underground uranium mine was operating in 1980 about 1 mi northwest of Kenosha Pass (fig. 1), and a small open-pit uranium mine was scheduled to start operating in the same area in the summer of 1981. These deposits are near, but outside of, the further planning area. The Tarryall mining district, south of the wilderness, originally produced precious and base metals in small quantities, but is better known for the beryllium produced in the 1950's and 1960's.

The Redskin Mine in Redskin Gulch (pl. 1), south of the wilderness, may have shipped a little molybdenum during World War I (Hawley, 1969, p. A33).

Mapping of the Bearcat Mine, south of the wilderness, during the present study indicates an estimated production of 960 to 1,600 tons of fluorite.

Pegmatites, near the wilderness, yielded more than 32,000 tons of potassium feldspar, and a few tons of biotite mica during the 1950's and 60's (Bureau of Mines files, Intermountain Field Operations Center, Denver, Colo. 80225, 1959).

The Redskin claims near Shawnee, north of the wilderness (pl. 1), produced 141 lbs of U_3O_8 (Nelson-Moore and others, 1978, p. 369).

MINING DISTRICTS AND MINERALIZED AREAS

The Kenosha Pass fluorite-uranium district and the Tarryall beryllium-tungsten-fluorite district (also known as the Badger Flats or Lake George district) are adjacent to the RARE II areas: Kenosha Pass on the northwest end of the further planning area and Tarryall south of the wilderness (fig. 1).

Courthouse records show 17 mining claims, which are located within the wilderness, and another 64 claims that are outside of the wilderness but within 1 mi of its boundary. None of these claims are patented.

The Kenosha Pass district produced a few tons of fluorite in 1913-14 (Traver, W. W., Jr., 1944, Guernsey (Kenosha Pass) fluorspar deposits, Park County, Colorado: War Minerals Report in Bureau of Mines files, Intermountain Field Operations Center, Denver, Colo. 80225). Uranium occurrences have been mined sporadically from 1956 to the time of the present field investigation. Uranium occurs as secondary uranium minerals in deeply weathered zones localized along fractures in the granite and surrounding gneiss. Although the bedrock geology is similar to that in parts of the wilderness, the Kenosha Pass district is much flatter than the wilderness, allowing for a greater degree of in-place weathering. Although adjacent to the former further planning area, the district is 5 mi outside the wilderness boundary and will not be discussed further.

Tarryall mining district

The Tarryall mining district, southwest of the wilderness, began as a placer gold district in the 1860's, but was of little importance until beryllium was discovered at the Boomer Mine, 3 mi south of the wilderness (not shown on pl. 1), in 1955. During approximately 10 years of operation, the Boomer produced about 150 tons of BeO (Nelson-Moore and others, 1978, p. 365). Other properties in the district made small contributions to the district's beryllium production.

Beryllium-bearing greisens occur as pipes in or near the Redskin Granite. Beryl and bertrandite are the principal beryllium minerals (Hawley, 1969, p. A11). The Boomer Mine was a major beryllium producer starting in 1956 (Meeves, 1966, p. 29).

In Redskin Gulch, less than 1 mi south of the wilderness (fig. 3), the Redskin, Minerva, and Black Prince workings explore greisen pipes in the porphyritic facies of the Redskin Granite (Hawley, 1969, p. A33). Sixteen samples were taken: three from the Redskin Mine, Four from the Minerva J workings, two from the Black Prince, one from the Minerva D-E-F (fig. 3), and six from other prospects. The Redskin Mine samples averaged 0.112 percent beryllium and 78 ppm U_3O_8 (nos. 77-79); the Minerva J samples averaged 0.067 percent beryllium and 12 ppm U_3O_8 (nos. 81-84); the Minerva D-E-F sample contained 0.018 percent beryllium and 10 ppm U_3O_8; and the Black Prince samples averaged 55 ppm U_3O_8, and one also contained 0.0031 percent beryllium. The seven scattered samples (pl. 1, nos. 69-72; fig. 3, nos. 76, 80) contained no detectable beryllium and averaged only 12 ppm U_3O_8. Molybdenite is present at the Redskin Mine; a chip sample taken across the greisen (sample 77) contained 0.05 percent molybdenum. One sample from each of three workings assayed more than 1 oz silver per ton.

Greisens also occur at the contact of the Silver Plume(?) Granite and a granite-aplite facies of the Redskin Granite on the A & C and Hazel Marie claims; the claims were located on the China Wall cupola (fig. 4), about 1 1/4 mi southwest of the wilderness boundary (Hawley, 1969, p. A30). The greisen here is hematite-stained; beryl crystals were found in one pit. Thirteen samples taken from prospects in the cupola averaged 0.04 percent beryllium, with a high of 0.269 percent beryllium (fig. 4, nos. 88-97; pl. 1, nos. 98-100).

Sample No.	Type	Description	Analytical data Be (percent)	Mo (percent)	U_3O_8 (ppm)
73	Dump	Shaft in greisen.	---	---	97
74	Dump	3 pits in greisen.	0.0031	---	13
75	Dump	Pit in granite.	.018	---	10
76	Dump	Pit in weak greisen.	---	---	13
77	5-ft chip	Across greisen.	.190	0.05	40
78	Dump	25-ft pit in greisen.	.063	---	29
79	Dump	Shaft in greisen pipe.	.083	.01	165
80	Dump	Shaft in greisen.	---	---	18
81	Dump	Shaft in greisen.	.051	---	15
82	Dump	Shaft in greisen.	.218	.002	22
83	Dump	Shaft in granite.	---	---	6
84	Dump	Trench in granite.	---	---	7

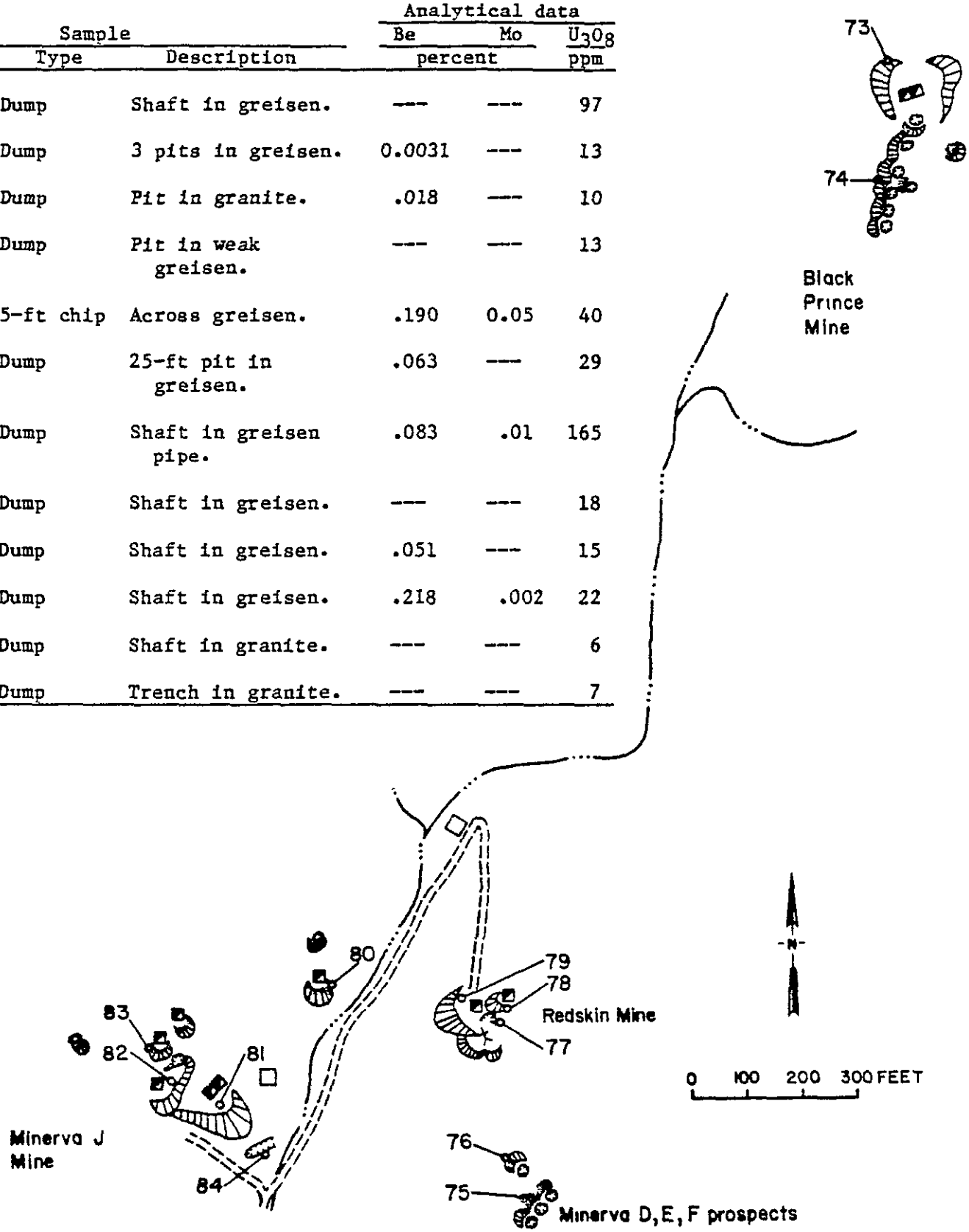


Figure 3.--Sketch of the Redskin Gulch area showing sample localities 73-84; table shows sample data. The symbol "---" on the table indicates the element was not detected.

Sample No.	Type	Description	Analytical data: Be (percent)	Mo (percent)	U_3O_8 (ppm)
88	6-ft chip	Trench in greisen.	—	—	4
89	Dump	18-ft pit in greisen.	0.269	—	7
90	3-ft chip	Pit in greisen.	.0026	0.002	7
91	Dump	Pit in greisen.	.157	.002	15
92	Dump	Shaft in greisen.	.011	—	7
93	Dump	Caved shaft in greisen.	.03	.004	17
94	4-ft chip	1-ft quartz vein.	.009	—	3
95	2-ft chip	Pit in greisen.	.003	.05	10
96	Dump	6-ft pit in greisen.	.0053	—	5
97	Dump	Caved pit in greisen.	—	—	4

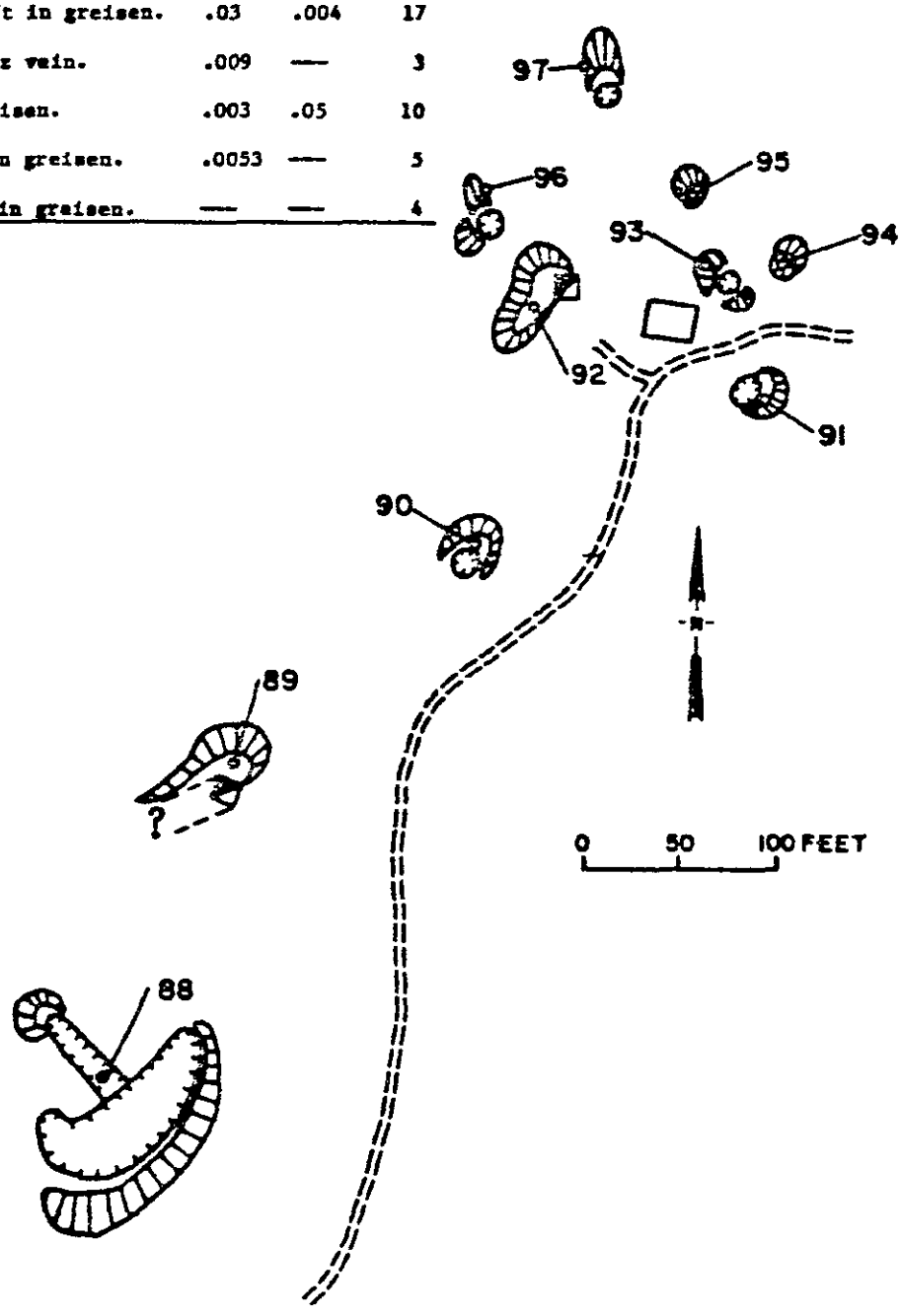


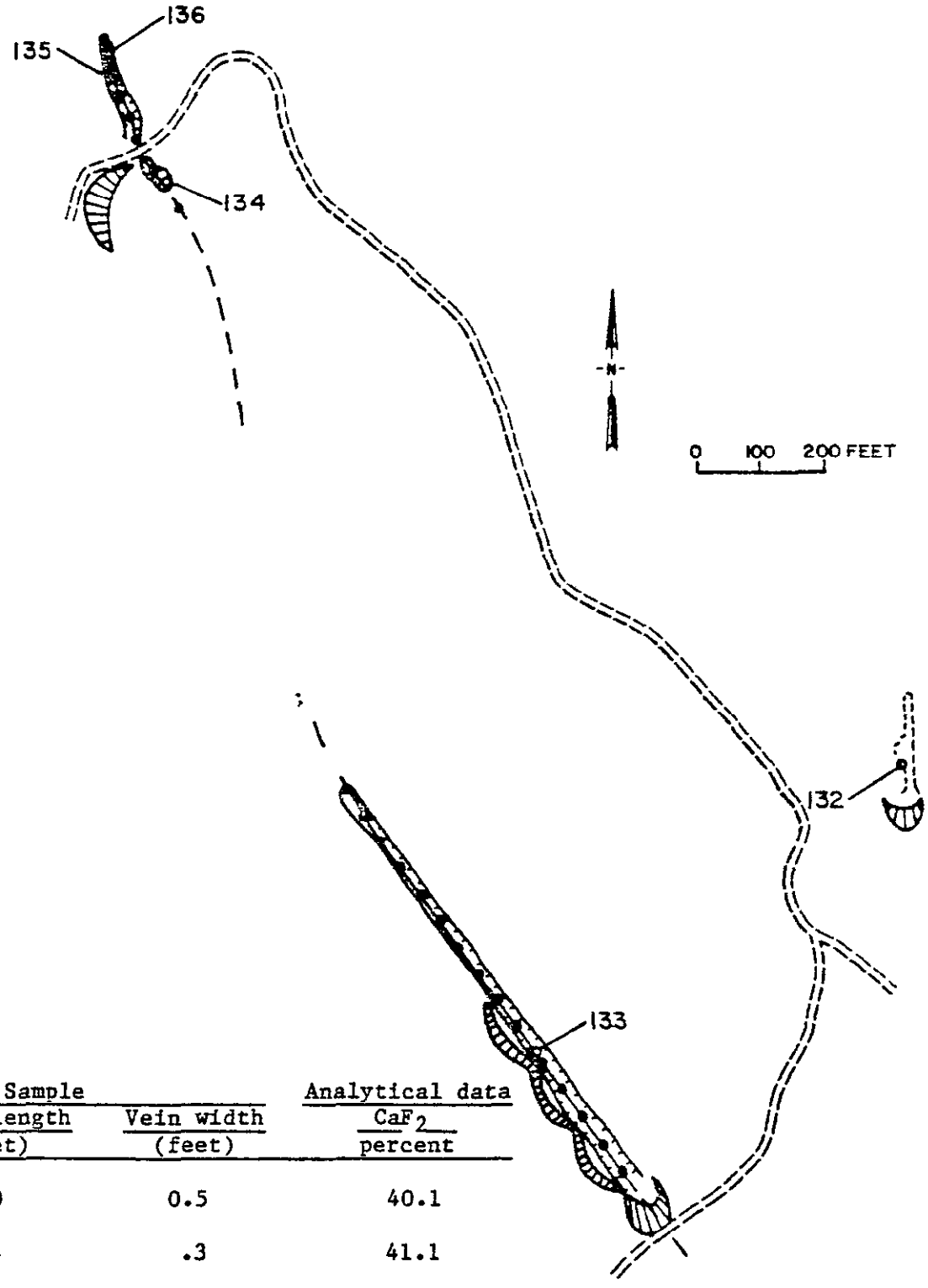
Figure 4.—Sketch of the China Wall cupola area, showing sample localities 88-97; table shows sample data. The symbol "—" on the table indicates the element was not detected.

Both known areas of beryllium-bearing greisens nearest the wilderness are near the edge of the Redskin Granite. The Redskin Granite extends into the southern part of the wilderness, and similar greisens should be expected here, and might constitute a beryllium resource in the wilderness. The terraine, along the Redskin Granite border in the wilderness, is very rugged compared to the terraine where greisens have been found.

A vertical, N. 25° W.-trending fluorite vein is exposed at the Bearcat Mine (fig. 5), less than 1 mi south of the wilderness. Trenching exposed the vein for about 1,200 ft along strike, but it was mined to a depth of about 20 ft for only about 200 ft along strike. Where mined, the vein is as wide as 2 ft, but the rest of the exposed 1,200-ft vein averages less than 1 ft in width. Just northwest of the mine, the vein pinches out completely; to the southeast it is narrow, but persistent. Where mined, no pinching was observed in the 20 ft of vein exposed downdip; therefore small resources remain below the mined level. The vein does not extend into the wilderness.

About 1/2 mi southwest of South Tarryall Peak approximately 650 yd^3 of material was removed from an open cut on a pegmatite (pl. 1, samples 107 and 108). Sample 107 (quartz) contained 93.0 percent SiO_2. Sample 108 (feldspar) contained 73.7 percent SiO_2, 17.3 percent Al_2O_3, 6.0 percent Na_2O, and 1.5 percent K_2O. Quartz and microcline are the main constituents of the pegmatite; biotite, lepidolite, and tourmaline are present, but rare. Approximately 1,000 tons of material was shipped from the cut. Feldspar may have been the only product shipped, as quartz is stockpiled on the site (table 1). Pegmatites are common throughout the wilderness.

At least 3 mi south of the wilderness, in belts of Precambrian gneiss separated by granite, are scheelite-bearing lenses of calc-silicate rocks (Tweto, 1960, p. 1413). Similar occurrences (skarns) may exist in the wilderness



No.	Sample: Chip length (feet)	Sample: Vein width (feet)	Analytical data: CaF_2 percent
132	2.0	0.5	40.1
133	.4	.3	41.1
134	1.0	.9	51.4
135	2.0	2.0	24.7
136	1.2	.3	36.0

Figure 5.--Sketch of the Bearcat Mine showing sample localities 132-136; table shows sample data.

where the Idaho Springs Formation contacts Silver Plume or Pikes Peak Granite (fig. 2). Wolframite and scheelite occur in greisens in the Silver Plume(?) Granite near Tappan Mountain, about 3 mi south of the wilderness (Hawley and Griffitts, 1968, p. 16). This type of occurrence could exist in the wilderness, possibly in any of the granites.

Numerous pits near the southern edge of the wilderness were dug by topaz collectors. Figure 6 shows prospects in greisens near Hay Creek which may have been either topaz or beryllium prospects. No beryllium was detected.

Miscellaneous areas and occurrences

Two mi northwest of The Castle and less than 1/2 mi northeast of the wilderness (pl. 1), the Lone and Lonesome pegmatite was mined for potassium feldspar, biotite, and, possibly, topaz. Minor fluorite and sparse lepidolite and columbite also are present.

Lovering and Goddard (1950, p. 71) referred to a Lost Park silver-lead deposit. An unpublished map by Goddard shows its location in sec. 26, T. 9 S., R. 72 W., but a Bureau of Mines mineral property file places the prospect in sec. 29 of the same township and range. In fact, more than one such silver-lead vein may exist, but a search of both areas by Bureau personnel revealed no trace of a metal deposit. Smoky quartz, fluorite, barite, and chrysoberyl were observed in prospects in sec. 26 near Refrigerator Gulch (table 1). Lead was present with the fluorite and barite, but not visible. Possibly, these are lead-silver prospects, although some of the pits are obviously mineral collecting sites.

The shaft symbol, shown on topographic maps on Goose Creek downstream from Refrigerator Gulch (pl. 1) well inside the wilderness, represents the remains of an attempt in the early 1900's to sink a shaft to the subterranean

Sample			Analytical data		
			Ag	Cu	Pb
No.	Type	Description	oz/ton	percent	
120	5-ft chip	Shaft in greisen.	1.0	0.02	1.0
121	Dump	Caved shaft in weak greisen.	.2	---	.2
122	Dump	Adit start in weak greisen.	.2	.02	.2
123	Dump	Trench in weak greisen.	---	---	---
124	Dump	Pit in weak greisen.	---	---	---

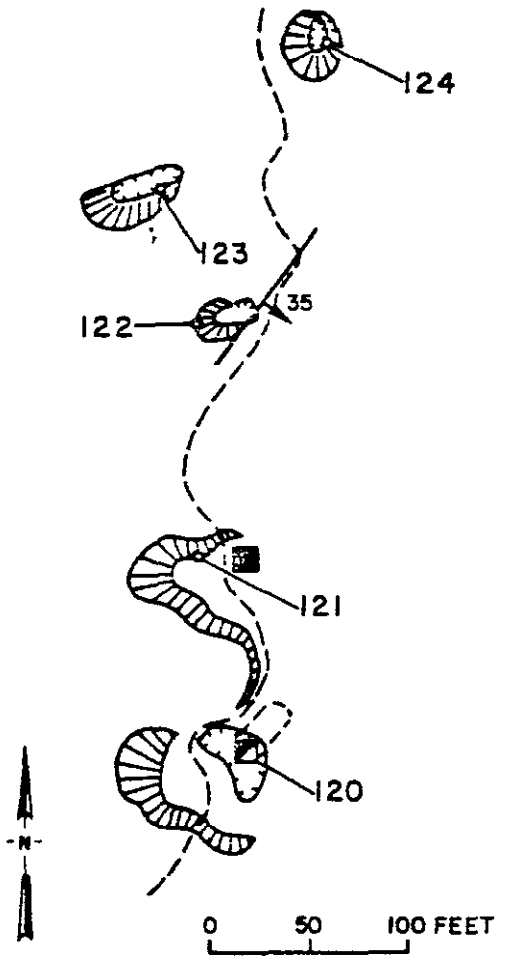


Figure 6.--Sketch of prospect area south of Hay Creek showing sample localities 120-124; table shows sample data. The symbol "---" on the table indicates the element was not detected.

Lost Creek and then pump in concrete to form an underground dam. The plan failed, however, when the water simply found passages around the concrete (Forest Service Lost Creek Scenic Area map, Pike National Forest).

Gallagher (1976, p. 16) reported radiometric backgrounds from uranium to be average in the Idaho Springs Formation, low in the Pikes Peak Granite, and high in the Silver Plume and Redskin Granites. During the present study, Bureau of Mines personnel found that the Idaho Springs Formation and the Pikes Peak Granite also have generally high radiometric backgrounds. In areas below timberline that are topographically flat or rolling, deep weathering may have resulted in secondary enrichment of the uranium. The Kenosha Pass deposits and the deposits at the Redskin claims near the town of Shawnee, just north of the wilderness, are examples of such weathering and secondary enrichment. Most of the area studied, however, is either too steep or above timberline, in few places is the bedrock deeply weathered. The exceptions are Craig Park, East Lost Park, and a few small meadows along various creeks. Scintillometer readings were background or lower in these areas.

A copper-iron prospect is located above Johnson Gulch (pl. 1) about 1 mi southwest of the northwest end of the wilderness. A 3-ft wide, malachite-stained vein of specular hematite is exposed in a shallow open cut (fig. 7). About 150 ft west of this exposure another vein, with 10 in. of specular hematite on the footwall, is exposed in a trench. The dump from a shallow shaft 150 ft northeast of, and almost on strike with, the second vein is composed of hematite-coated gneiss. The country rock is Idaho Springs Formation calc-silicate gneiss. The contact with Boulder Creek Granodiorite and Silver Plume Granite is not far away (Tweto, 1979), and the granite could be the source of the mineralization. Mineralization is scant or absent in the

Sample			Analytical data	
			Fe	Cu
No.	Type	Description	percent	
161	4.5-ft chip	3-ft specularite vein.	19.5	1.0
162	Dump	Shaft in gneiss.	15.5	.1
163	4-ft chip	3-ft specularite-quartz vein.	17.0	.07
164	Dump	Trench in gneiss.	10.0	.07
165	2-ft chip	Trench in gneiss and marble.	---	---
166	Dump	Trench in gneiss and marble.	---	---
167	5-ft chip	Trench in gneiss and marble.	---	---

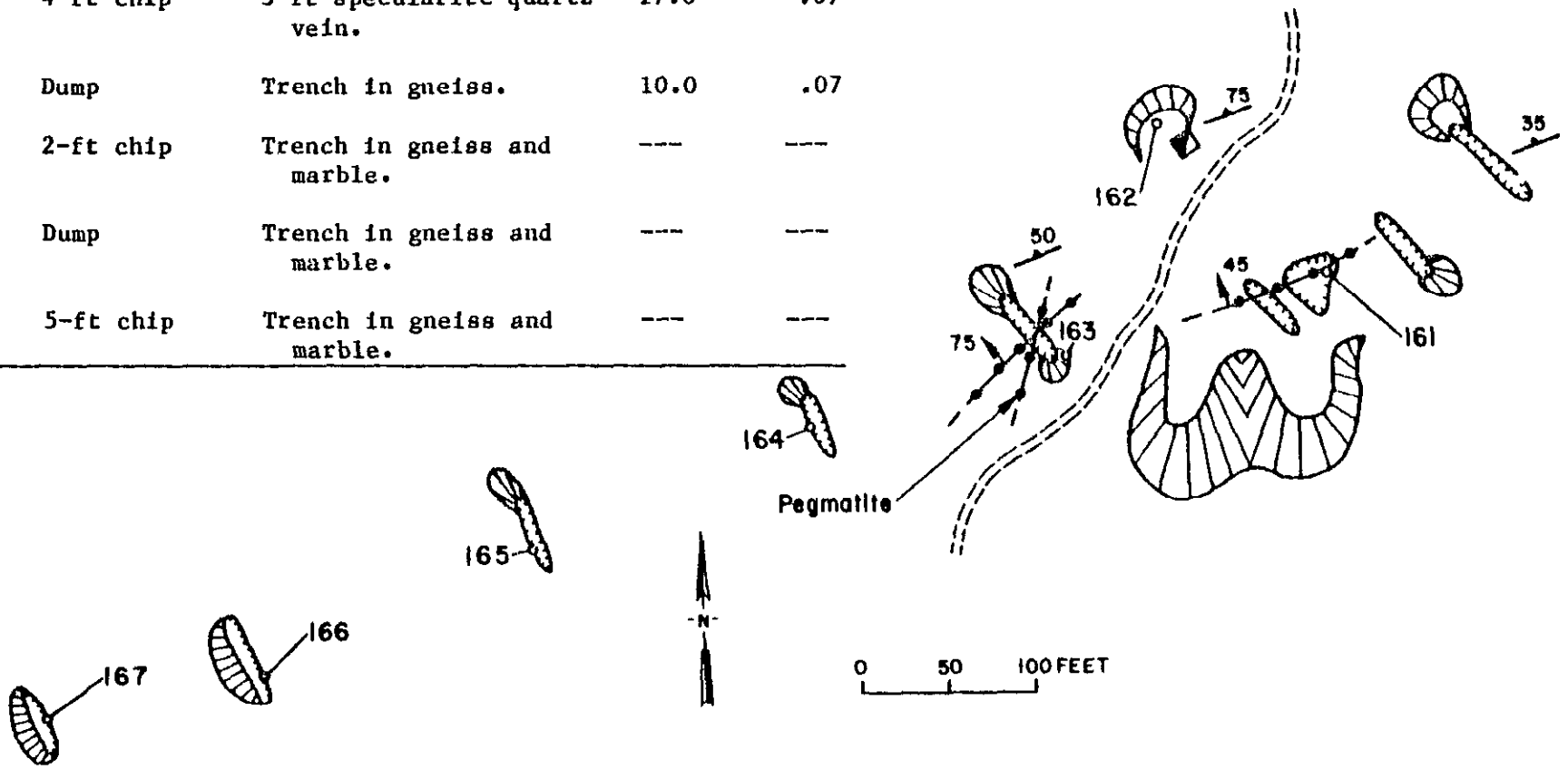


Figure 7.--Sketch of prospect near Johnson Gulch showing sample localities 161-167; table shows sample data. The symbol "---" on the table indicates the element was not detected.

other trenches of the prospect. Insufficient evidence is available to identify a resource at this prospect.

An adit in gneiss of the Idaho Springs Formation is about 1 1/2 mi north of the wilderness, near Glenisle (pl. 1). Traces of copper, silver, and molybdenum were found in samples from the adit (fig. 8).

There were no oil and gas leases or applications in or near the wilderness as of July 1980.

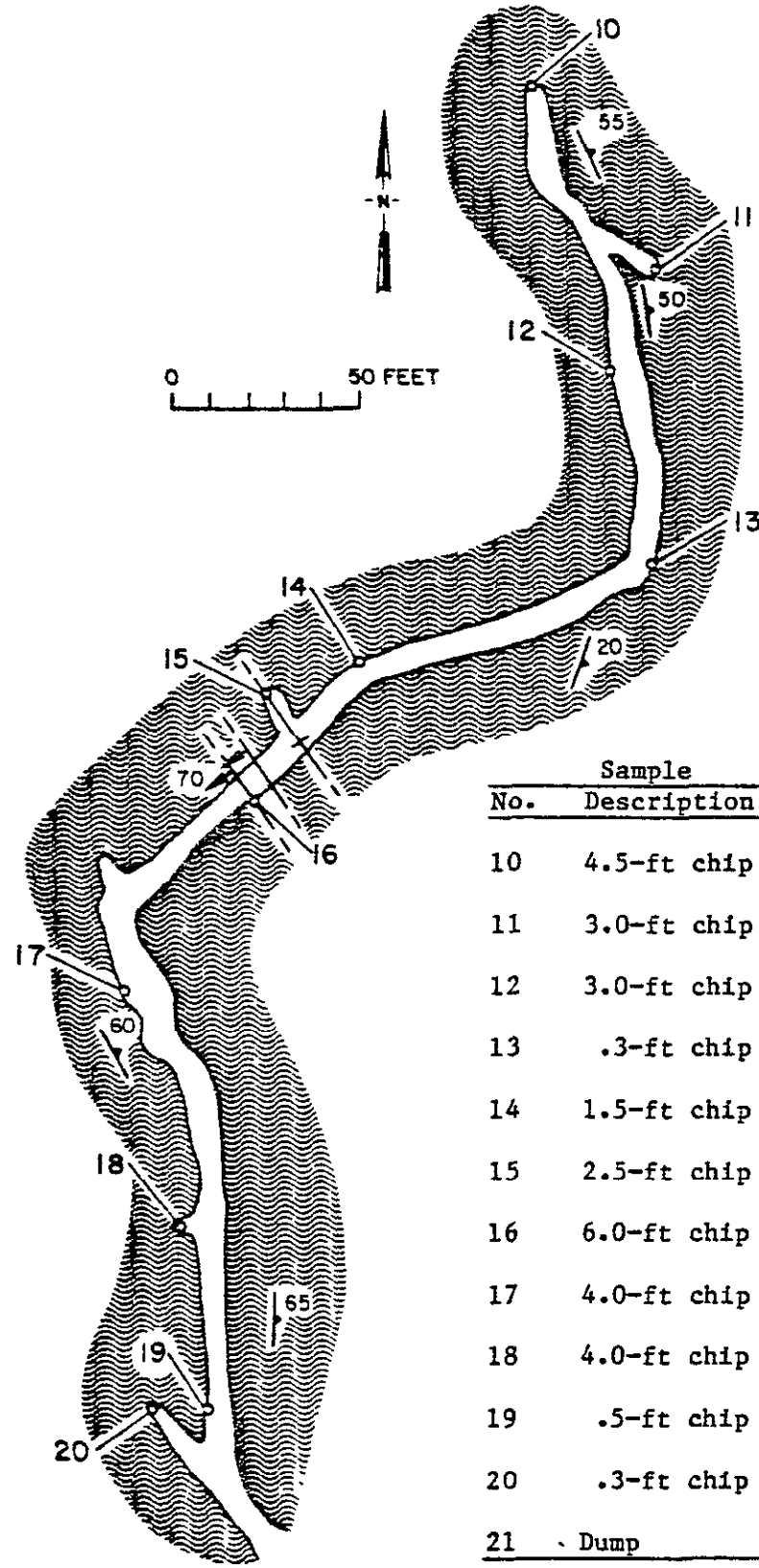
CONCLUSIONS

Although no mineral resources, other than mineral specimens, were identified by the Bureau of Mines in the Lost Creek Wilderness, beryllium deposits may exist around the border of the Redskin Granite (fig. 2). One known mineral specimen resource is near Refrigerator Gulch.

Fluorite veins are not uncommon in the area, but few are of minable size. The Bureau did not identify a fluorite resource in the wilderness.

Although pegmatites are common in the wilderness and surrounding areas, only a little mineral production, primarily potassium feldspar, has resulted from them. None of the pegmatites inside the wilderness have been mined. The rare minerals (columbite, lepidolite, spodumene, beryl, etc.) found in complex pegmatites have been detected in the pegmatites mined, but the quantities have been minute, and no recovery has been recorded. Potassium feldspar can be recovered either from pegmatites or from the Pikes Peak Granite at many locations in the region.

Tungsten-bearing skarns may exist in the gneisses of the Idaho Springs Formation near contacts with the Silver Plume and Pikes Peak Granites within the wilderness, but none has been discovered. Those skarns prospected outside the wilderness have no recorded production.



Sample No.	Description	Analytical data Ag oz/ton	Cu percent	Mo percent
10	4.5-ft chip	---	---	0.001
11	3.0-ft chip	0.2	0.005	---
12	3.0-ft chip	.4	---	---
13	.3-ft chip	---	---	---
14	1.5-ft chip	.2	.001	.005
15	2.5-ft chip	---	.003	---
16	6.0-ft chip	.2	.003	---
17	4.0-ft chip	---	.003	---
18	4.0-ft chip	---	---	.001
19	.5-ft chip	.2	---	.02
20	.3-ft chip	---	---	.001
21	Dump	.2	.001	---

Figure 8.--Map of the adit north of Glenisle showing sample localities 10-21; table shows sample data. The symbol "---" on the table indicates the element was not detected.

Molybdenum is associated with beryllium or tungsten occurrences in this region. Small amounts could be persent in undiscovered greisens or skarns, if they exist in the wilderness.

Uranium, which is generally slightly more plentiful in granites of the area than in granites in general, has been concentrated by weathering in fracture zones near Kenosha Pass. The concentrations exist where relatively flat topography and heavy vegetative growth allow deep in-place weathering; however, the wilderness is virtually devoid of flat topography below timberline, except for Craig Park, East Lost Park, and smaller but similar, relatively flat parts of these and other drainages.

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_____ 1979, Geologic map of Colorado: U.S. Geological Survey, scale 1:500,000.

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Mineral Resource Potential of the Greenhorn Mountain Wilderness Study Area, Huerfano and Pueblo Counties, Colorado

By

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

[1]U.S. Geological Survey

[2]U.S. Bureau of Mines

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Greenhorn Mountain Wilderness Study Area, San Isabel National Forest, Huerfano and Pueblo Counties, Colo. The Greenhorn Mountain Wilderness Study Area was so established by the Colorado Wilderness Act, Public Law 96-560, December 22, 1980.

MINERAL RESOURCE POTENTIAL
SUMMARY STATEMENT

Mineral resource studies by the U.S. Bureau of Mines and U.S. Geological Survey indicate that one area within the Greenhorn Mountain Wilderness Study Area has low to moderate mineral resource potential. Chemical analyses of stream-sediment samples suggest that the Precambrian igneous and metamorphic rocks underlying the drainage basin of South Apache Creek have very high concentrations of tungsten. Although mineralized rock was not located, similar Precambrian rocks elsewhere in Colorado have tungsten in skarn-type deposits. The potential for tungsten in this basin is deemed low to moderate on the basis of geologic environment and the tungsten geochemical anomaly. The Greenhorn Mountain Wilderness Study Area has no known potential for oil and gas, coal, geothermal resources, or other energy-related commodities.

INTRODUCTION

The Greenhorn Mountain Wilderness Study Area (WSA) in south-central Colorado covers about 22,300 acres in Huerfano and Pueblo Counties (fig. 1). It lies 20 mi southwest of Pueblo and 130 mi almost due south of Denver. Cities within 10 mi include Rye to the northeast, San Isabel to the north, and Gardner to the southwest.

The Greenhorn Mountain WSA lies across the southernmost end of the Wet Mountains and is characterized by a steep eastern flank with V-shaped canyons and a gently sloping western side typified by flat-bottomed arroyos. Elevations range from 12,347 ft at Greenhorn Mountain to 7,600 ft at the southern end of the WSA. Badito Cone, a round symmetrical peak (8,942 ft) rises prominently just south of the WSA boundary. Access to the periphery of the study area is provided by dirt roads, one of which leads nearly to the top of Greenhorn Mountain. Foot trails provide access to the interior of the WSA and traverse across the Wet Mountains.

A mineral survey of the Greenhorn Mountain WSA was done by the U.S. Geological Survey (USGS) during the summer of 1982 and by the U.S. Bureau of Mines (USBM) during September and October 1981 and June 1982. The USBM studied mines, prospects, and mineralized areas (Baskin, 1983), and the USGS performed geological and geochemical investigations. This report summarizes the findings of the mineral survey and assesses the mineral resource potential of the WSA. A geologic map of the southern Wet Mountains by Boyer (1962) was field checked and modified for the geologic base map used in this report (fig. 2). Information on oil and gas potential was obtained from reports by Creely and Saterdal (1956) and Landes (1970).

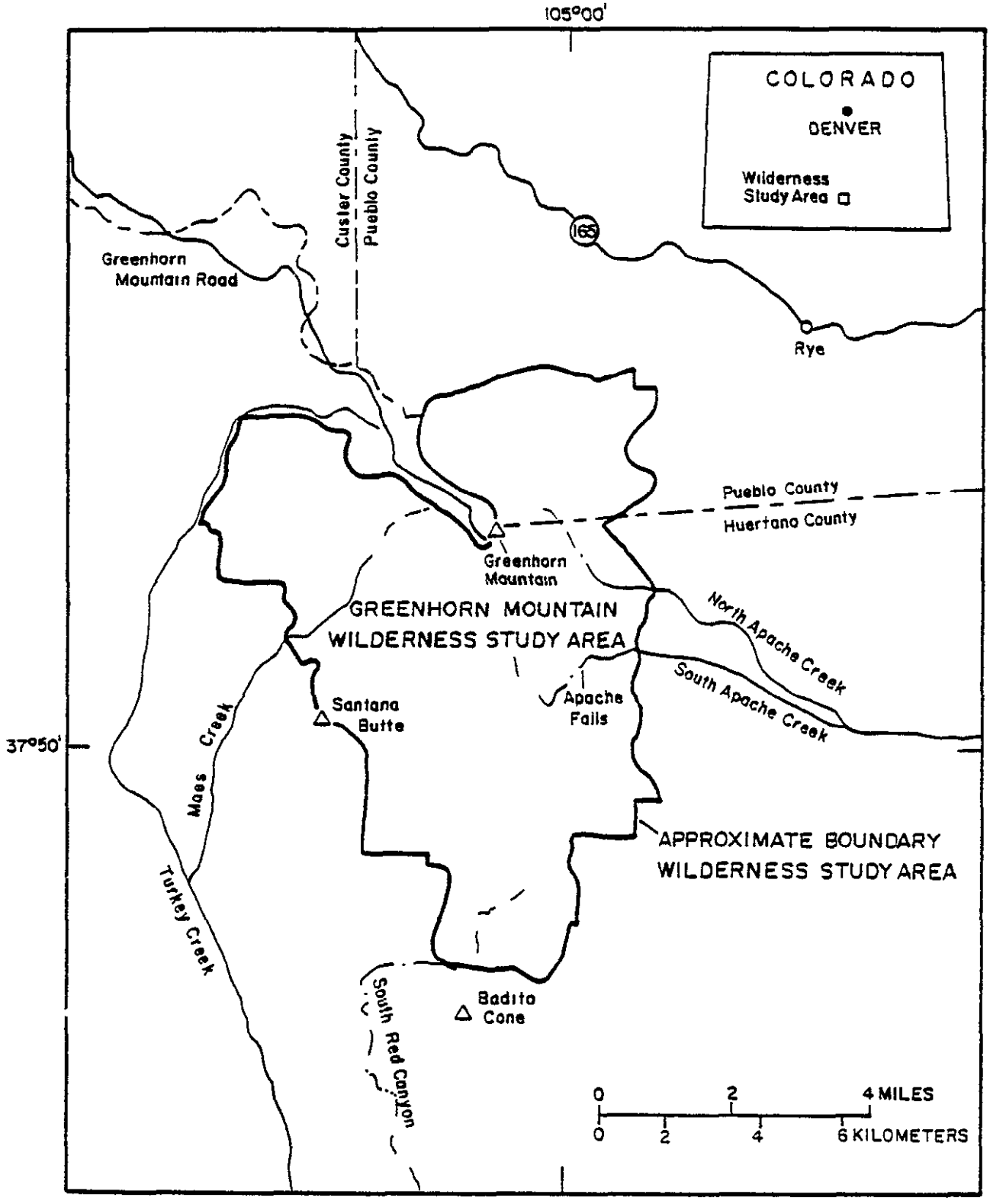

Figure 1.—Index map showing location of the Greenhorn Mountain Wilderness Study Area, Huerfano and Pueblo Counties, Colo.

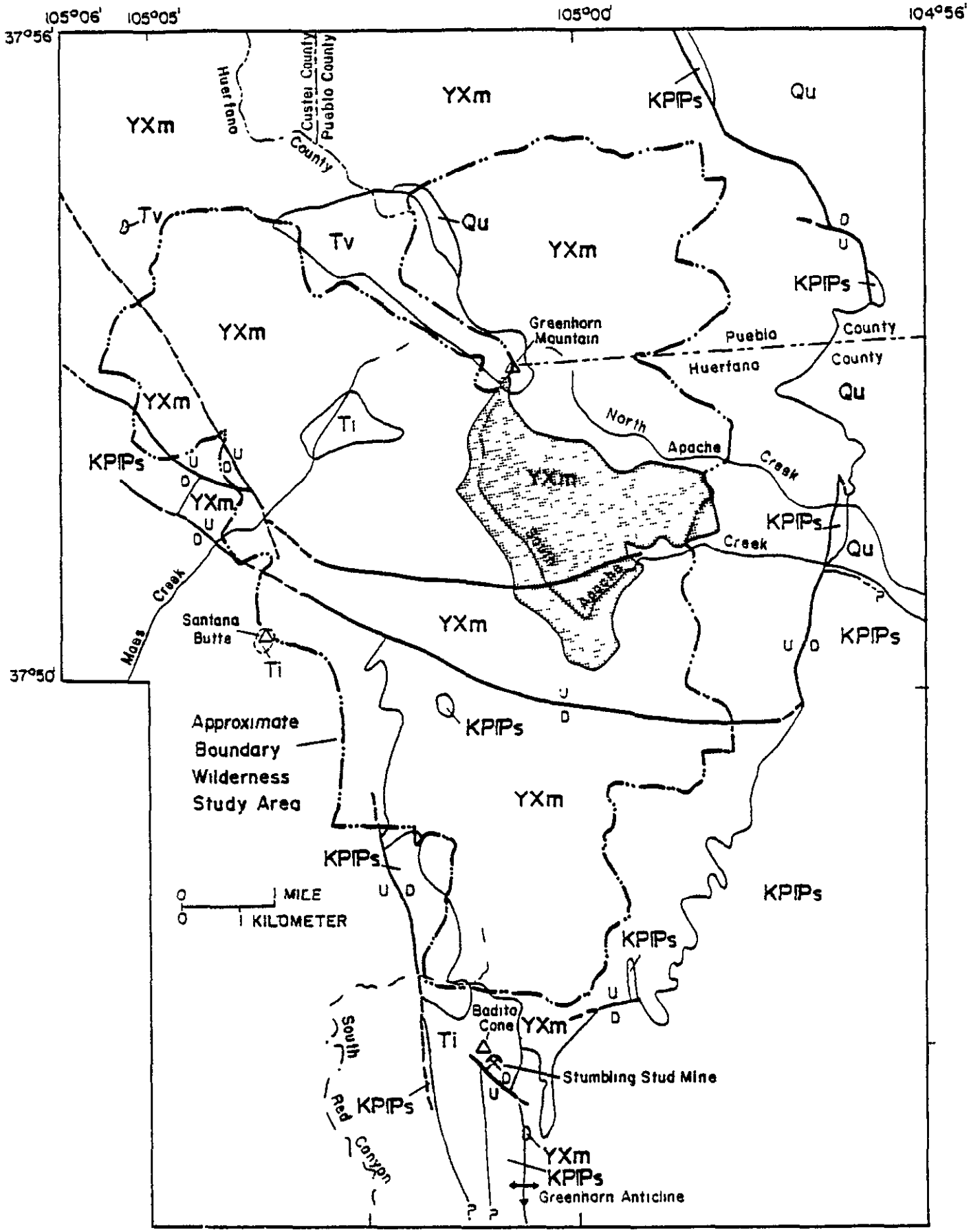

Figure 2.—Map showing geology and location of areas of mineral resource potential in the Greenhorn Mountain Wilderness Study Area. (Description of map units and explanation on following page).

DESCRIPTION OF MAP UNITS

Qu	UNDIFFERENTIATED ALLUVIUM AND TALUS (QUATERNARY)
Tv	VOLCANIC ROCKS (TERTIARY)
Ti	INTRUSIVE ALKALIC IGNEOUS ROCKS (TERTIARY)
KPIPs	SEDIMENTARY ROCK (CRETACEOUS TO PERMIAN-PENNSYLVANIAN)
YXm	METAMORPHIC AND INTRUSIVE IGNEOUS ROCK (PROTEROZOIC (X) AND PROTEROZOIC (Y))
———— - - -?	CONTACT--Dashed where approximately located or inferred. Queried where extension is uncertain
———— - -	FAULT--U, upthrown side; D, downthrown side. Dashed where approximately located
	ANTICLINE--Showing trace of axial plane and direction of plunge of axis
	MINE
	AREA DRAINED BY STREAMS WITH ANOMALOUS TUNGSTEN IN SEDIMENT SAMPLES
——··——··——	APPROXIMATE BOUNDARY OF GREENHORN MOUNTAIN WILDERNESS STUDY AREA

GEOLOGIC SETTING

The core of the Greenhorn Mountain WSA consists of complexly related Proterozoic X granite gneiss, hornblende gneiss, amphibolite, biotite and biotite-hornblende schist, migmatite, and minor amounts of calc-silicate gneiss and Proterozoic Y San Isabel Granite. Unconformably overlying the basement rock are Permian-Pennsylvanian to Cretaceous interlayered conglomerate, sandstone, siltstone, shale, and limestone as much as 4,150 ft thick. Tertiary alkalic hypabyssal rocks intrude the Precambrian sedimentary rocks at Badito Cone, in Maes Creek, and at Santana Butte. The intrusive rocks are white to light gray and contain 5-10 percent phenocrysts of plagioclase, oxyhornblende, and acmite in an aphanitic groundmass. The ages of the stocks are unknown but may be Miocene, based on correlation with similar appearing rocks in the adjacent Huerfano Park (Briggs and Goddard, 1956). Crystal-vitric rhyolite tuff of both lacustrine and fluvial origins and of Oligocene(?) or Miocene(?) age is preserved in the southwestern and northeastern faces of Greenhorn Mountain. Overlying the rhyolite tuff are erosional remnants of several dark-green to black andesitic lava flows as much as 100 ft in composite thickness, and of Oligocene(?) or Miocene(?) age. The flows contain 5-20 percent phenocrysts of plagioclase, augite, and oxyhornblende in an aphanitic groundmass.

The southern Wet Mountains form a southeast-plunging anticline defined by tilted sedimentary rocks that flank the range and wrap around its southern end. The mountains are bounded by high-angle, northwest-trending normal faults on both the east and west sides of the range. Also trending northwest, minor faults, dikes, and joint sets parallel the elongation of the range, but strike east-west in places. Faults are commonly expressed as brecciated zones that contain hematite, chlorite, and epidote, and abundant slickensides. Several periods of faulting are recognized, and most faults have Laramide (late Campanian Cretaceous to late Eocene) or younger movement; the youngest faults are commonly marked by breaks in the topographic slopes. An extensive, nearly flat erosion surface was formed in late Eocene time before mid-Tertiary uplift of the range, and remnants of it are present along the crest of the mountains near Greenhorn Mountain and beneath the volcanic rocks forming this peak.

GEOCHEMICAL SURVEY

A geochemical survey of the WSA by the USGS included sampling stream sediments and rocks for chemical analysis. Thirty-one samples of stream sediments were taken; the drainage basin areas of the streams varied between 2 and 3 mi^2. The samples were collected as close to the WSA boundary as was feasible, but as most of the sedimentary rocks on the east side of the range crop out east of the WSA boundary, these were not included in the sampling. Large-volume composite samples were collected at each stream site and were separated into three fractions before analysis. Different concentrating techniques were used to produce a fine fraction (consisting mostly of clays), nonmagnetic fraction (consisting of nonmagnetic minerals greater than clay size), and a magnetic fraction (consisting of magnetic minerals greater than clay size). These concentrating techniques were used to enable better recognition of anomalous samples. Composite rock samples were also taken of fresh representative bedrock outcrops and also wherever alteration or evidence of mineralization was present.

All samples were analyzed for 30 elements by six-step semiquantitative emission spectrography (Grimes and Marranzino, 1968). The data for each element were composited into histograms for the various fractions of the stream sediments and for the rock samples. Chemically anomalous samples were defined as the higher population wherever a well-defined separation was present in the data. Analyses of these anomalous samples were usually 2 or 3 spectrographic intervals higher than the rest of the analyses.

The stream-sediment samples from the Greenhorn Mountain WSA generally lack anomalous concentrations of elements associated with metallic deposits. Isolated anomalies are present for some elements but could not be traced to a geologic source. Barium and lanthanum are slightly anomalous in many stream samples; one sample from South Red Canyon contains 10,000 ppm barium in the nonmagnetic fraction of the sediment sample. Anomalous thorium (200 ppm) is present in the nonmagnetic fraction of a sample from Turkey Creek; tin was detected in the nonmagnetic fraction of four widely spaced samples, ranging in concentration from 20 to 50 ppm. A slightly anomalous tungsten content (100-150 ppm) is present in the sediments from streams draining Precambrian igneous and metamorphic rocks in the southernmost part of the WSA.

Stream-sediment samples from six adjacent streams draining into South Apache Creek contain anomalous amounts of barium, lanthanum, yttrium, and tungsten. Three of the streams also have highly anomalous tungsten (100, 300, and 500 ppm) in the nonmagnetic fraction, and the two drainages to the north of South Apache Creek also contain anomalous tungsten (100 and 150 ppm) in this fraction. Reconnaissance geologic studies did not locate a geologic source for this tungsten, and chemical analyses of samples from the granite gneiss in this area did not indicate chemical anomalies, except for a barium content slightly higher than normal for this rock type.

Rock samples from the Greenhorn Mountain WSA are also low in metals associated with mineralized systems; and most of the geochemical anomalies that were found are restricted to isolated samples. Barium, chromium, and nickel have anomalous values in a few igneous and metamorphic rock samples from widely separated localities, and tin was detected in a biotite-hornblende-plagioclase gneiss (30 ppm). Boron is present in anomalous concentrations (200 ppm) in a tourmaline-rich pegmatite.

The Tertiary alkalic stocks around Badito Cone (outside of WSA) and in Maes Creek contain anomalous amounts of niobium (70 and 150 ppm). Along the northeast margin of the stock at Badito Cone, metals occur in an inlier of sedimentary rock along a narrow fault zone in the Dakota Sandstone, just below the contact with the Graneros Shale. The sandstone contains detectable amounts of molybdenum (30 and 50 ppm) and arsenic (300 ppm); it has a high zirconium content (1,000 ppm). Because of its proximity and composition, the highly differentiated alkalic stock is regarded as the source for the metals which were deposited in the sandstone. No anomalous concentrations of any elements were detected in the streams draining the mineralized area.

SCINTILLOMETER SURVEY

A reconnaissance scintillometer survey of the WSA was made by recording measurements at randomly distributed locations and along obvious shear zones. By taking a large number of measurements, we were able to establish

the background radiation level (2,000-4,000 counts per second (cps)) and therefore define anomalous radiation levels.

Most of the measurements were within the range of the expected background, but one sample from a fault zone in granite gneiss on the west side of the WSA has 7,500 cps; the source of radiation is unknown. The mineralized Dakota Sandstone at the Stumbling Stud Mine south of the WSA has anomalous radiation of 5,000 cps (Baskin, 1983), and background readings are 80 cps for unaltered rock. These high radiation levels are most likely due to anomalous concentrations of uranium and thorium in the sandstone.

MINES, PROSPECTS, AND MINERALIZED AREAS

Fifty samples from known mines, prospects, and mineralized zones were collected by the USBM for analysis (Baskin, 1983). Samples at the workings consisted of chip samples taken across visible or suspected zones of altered or mineralized rock, and grab and select samples of dump material. Most samples were analyzed for gold and silver by fire-assay, U_3O_8 by radiometric analysis, specific elements in selected samples by atomic absorption, and 40 elements by semiquantitative spectrographic analysis. Results of all analyses are available for public inspection at the USBM, Intermountain Field Operations Center, Denver Federal Center, Denver, Colo. 80225.

Mining history and production

Prospecting in and around the WSA probably began in the late 1860's but there are no records of production before 1900. Most of the workings in and near the WSA are small prospect pits, probably dug for gold or silver. There is no evidence of production from any prospects examined in the WSA.

Several oil and gas leases and lease applications were on record in the WSA and vicinity in September 1982. Only about 100 acres of the WSA were covered by oil and gas lease application and no test drilling has taken place on those properties.

Mining districts and mineralized areas

No mining districts are in or near the Greenhorn Mountain WSA but several small prospects are inside the WSA boundary.

The Maes Creek prospects on the western boundary consist of a few small pits and one 20-ft adit, and the Apache Falls prospect on the eastern boundary consists of one small pit. Scant mineralization is present in the gneisses and granitic gneisses at these workings; assay results from samples taken at these workings show only minor amounts of copper (Baskin, 1983). The Greenhorn Mountain prospects on the northern boundary consist of two small pits in gray andesite; a trench on the Red Canyon claims on the southern boundary is in alluvium. Samples taken from these locales contain no significant amounts of silver, gold, or uranium.

Two mineralized areas lie approximately 1 mi outside the boundary of the WSA. To the northwest of the WSA, the Little Joe claims are staked along a fault zone in quartz-biotite gneiss and biotite schist. Specular hematite occurs in sheared and fractured quartz lenses, blebs, and veinlets that are

approximately parallel to the foliation in the gneiss. Two of three samples taken at this location assayed 0.2 oz silver per ton; gold was not detected. Although the fault extends about 1,000 ft inside the WSA, no evidence of mineralization was found along this fault inside the study area.

To the south of the WSA, the Stumbling Stud Mine consists of a group of pits and trenches along a contact between inliers of Cretaceous Dakota Sandstone in a Tertiary alkalic stock. Fluorite and uranium occur as disseminations and veinlets in the sandstone and in lesser amounts in the stock, and appear to be confined primarily to the area around the contact between the intrusive and the sandstone. None of the mineralized area extends into the WSA. Samples from the workings contained as much as 0.12 percent U_3O_8, 0.07 percent V_2O_5, 5.98 percent fluorine, and 1.4 percent zirconium (Baskin, 1983). Production of 510 tons of uranium-bearing rock was reported, but no uranium was extracted because it is chemically bound to a refractory mineral (Nelson-Moore and others, 1978).

The alkalic stock at Badito Cone extends to the southern boundary of the WSA where it is in contact with Precambrian granitic gneisses. The intrusive-sandstone contact does not extend into the WSA and no mineral occurrences of the type described above were observed in the WSA. Two similar stocks crop out in the area of Maes Creek and Santana Butte; the stock in Maes Creek intrudes Precambrian gneiss and the stock at Santana Butte intrudes Cretaceous sediments. No evidence of mineralization was observed at either locality.

Creely and Saterdal (1956) report favorable structural and stratigraphic conditions for oil and gas reserves immediately south of the WSA within the Greenhorn anticline. Most of the drill holes reported by them had shows of oil and (or) gas but none of the holes had any production as of 1956. Although part of the Greenhorn Anticline extends into the WSA, closed structures, which act to trap oil and gas, are absent. Furthermore, extensive erosion has removed the vast bulk of the sedimentary rocks that Creely and Saterdal (1956) report as favorable for oil and gas reserves. No potential for oil and gas is inferred inside the WSA.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Geological, geochemical, and scintillometer surveys, combined with the examination of mines, prospects, and claims, revealed few indications of near-surface mineral resources within the Greenhorn Mountain WSA; thus, there is little likelihood for occurrence of mineral resources in most of the WSA. Our studies indicate that one area in the WSA has a low to moderate mineral resource potential (fig. 2).

Most of the geochemical anomalies in the stream-sediment and rock samples are isolated in their occurrence, are low in value, and have no known geologic source. One cluster of barium, lanthanum, yttrium, and tungsten anomalies is present in the streams draining into South Apache Creek. Although tungsten occurrence is indicated for this area, our mapping did not locate evidence of mineralization in the Precambrian rocks in these drainages. Comparison with other tungsten-bearing Precambrian rocks elsewhere in Colorado (Tweto, 1960; Heinrich, 1981) suggests that large inclusions of calc-silicate gneiss or amphibolite in the Precambrian granite gneiss are a likely source for the tungsten. Detailed mapping would be necessary to establish the location of

the mineralized rock in the area of the stream anomalies. The mineral potential for tungsten assigned to this area is therefore low to moderate.

There is no known geological evidence for nonmetallic resources, oil and gas, coal, geothermal resources, or other energy-related commodities within the WSA.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1542-C
PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE SPANISH PEAKS WILDERNESS STUDY AREA, HUERFANO AND LAS ANIMAS COUNTIES, COLORADO

By

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Spanish Peaks Wilderness Study Area, San Isabel National Forest, Huerfano and Las Animas Counties, Colo. The area was established as a wilderness study area by Public Law 96-560, December 22, 1980.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

A geologic and geochemical investigation and a survey of mines and prospects have been conducted to evaluate the mineral resource potential of the Spanish Peaks Wilderness Study Area, Huerfano and Las Animas Counties, in south-central Colorado. The study area is underlain by sedimentary rocks of Paleozoic to Tertiary age (Johnson, 1969). Stocks and dikes were emplaced between 20 and 25 m.y. ago (Smith, 1979) forming East and West Spanish Peaks and the White Peaks.

Most of the study area lacks significant geochemical anomalies and has a low mineral potential. Anomalous concentrations of gold, silver, copper, lead, and zinc in the rocks and drainage basins in the vicinity of the old mines and prospects on West Spanish Peak indicate a moderate potential for small mineralized veins in this area. Ore-bearing veinlets have been worked in the past, primarily for silver and lead; however, the sparsity, small size, and low grade of the veins diminish their significance.

The depth of several thousand feet at which coal may underlie the surface rocks of the study area makes it a resource with little likelihood of development. The potential for oil and gas appears low because of the apparent lack of structural traps and the intense igneous activity in the area.

INTRODUCTION

The Spanish Peaks Wilderness Study Area covers about 19,570 acres of the San Isabel National Forest in south-central Colorado (fig. 1). The study area is in the westernmost part of the Great Plains, bordering the eastern foothills of the Sangre de Cristo Mountains. Elevations range from 13,626 ft on the summit of West Spanish Peak to about 8,400 ft in the western part, near Cuchara. The east half of the study area is characterized by rugged terrain in which the land and drainages slope radially away from East and West Spanish Peaks. The principal drainages are Wahatoya and Trujillo Creeks. In the west half of the study area, the terrain is less severe. The major drainages are the north-flowing Chaparral and Echo Creeks. North, Middle, and South White Peaks (elevation 10,446 ft) are near the west boundary of the study area.

Colorado Highway 12 and the Cucharas River parallel the study area on the west. U.S. Forest Service Route 415 and the Apishapa River parallel the southern margin. Secondary roads are sparsely located near the boundary of the study area.

Details of the geology of the study area (Budding and Lawrence, 1983b) and the results of the geochemical survey (Budding and Lawrence, 1983a) are presented as separate maps of the Spanish Peaks Wilderness Study Area. Only the aspects of the work pertinent to resource appraisal are included here. No geophysical work was done.

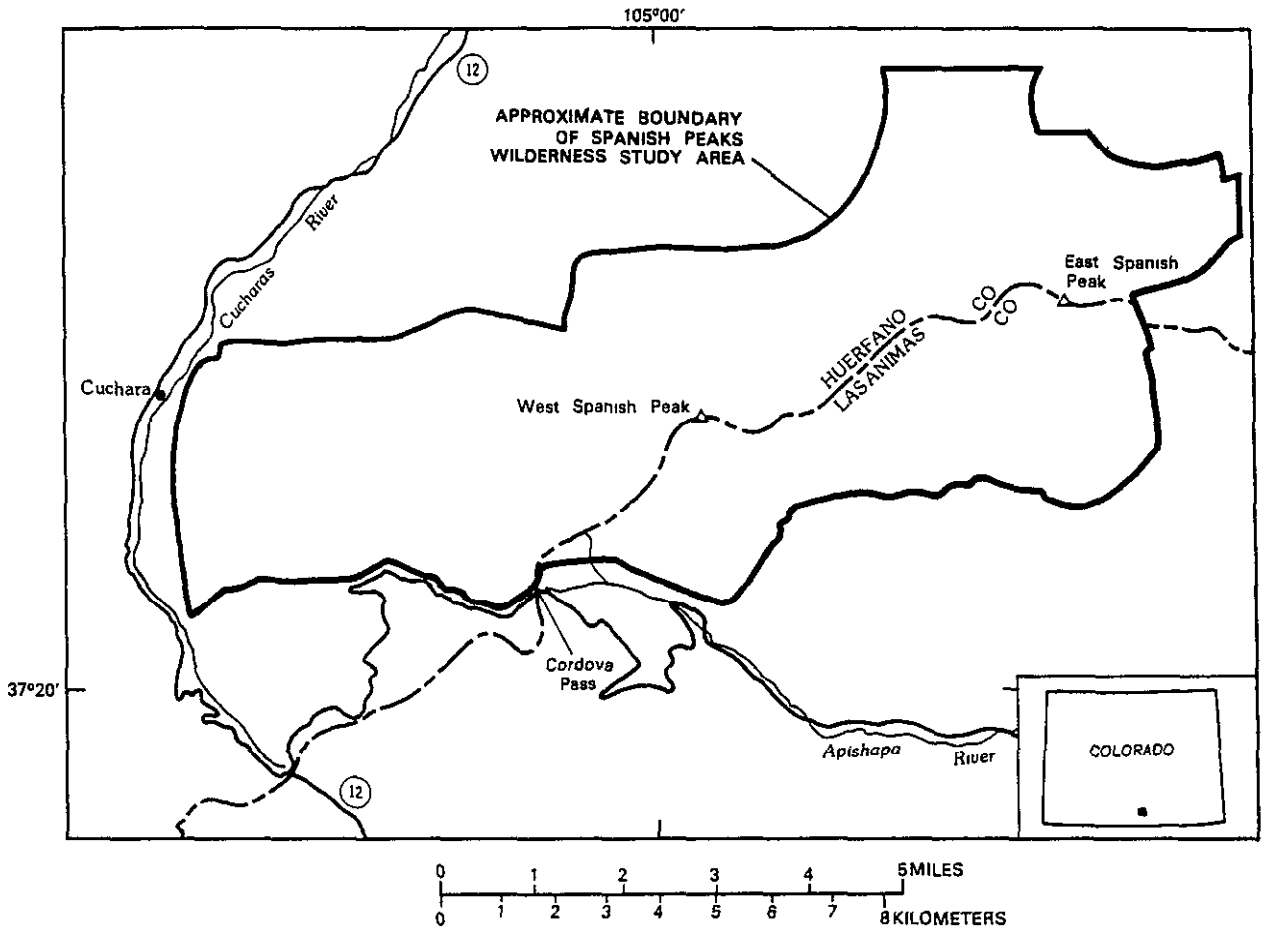


Figure 1.—Index map showing location of the Spanish Peaks Wilderness Study area, Huerfano and Las Animas Counties, Colo.

GEOLOGY

Sedimentary rocks, Paleozoic to Tertiary in age, crop out near the Spanish Peaks. In the western part of the study area, these include sandstone, shale, limestone, siltstone, coal, and conglomerate from the Upper and Lower Cretaceous Dakota Sandstone upward through the Paleocene Poison Canyon Formation (Johnson, 1969). Most of the sedimentary rocks are included in the Eocene sandstone, siltstone, claystone, and shale of the undifferentiated Cuchara and Huerfano Formations (Robinson, 1966; Scott and Taylor, 1975).

The sedimentary rocks were invaded by the granite porphyry of East Spanish Peak 21.7±1.0 m.y. ago (Stormer, 1972); this event was closely followed by the intrusion of the compositionally similar granite of North, Middle, and South White Peaks. The core of East Spanish Peak was then intruded by porphyritic granodiorite. The syenodiorite of West Spanish Peak was emplaced 22.9±2.0 m.y. ago (Smith, 1973) and is composed of several compositional varieties of syenodiorite. A large aureole of metamorphosed sedimentary rocks surrounds the body of syenodiorite. An impressive swarm of radial dikes, having trends related to stresses developed around the West Spanish Peak during magmatic activity, is found in the study area. Four radial dikes south of the peaks range in age from 22.4±3.1 m.y. to 28.5±5.0 m.y. (Smith, 1973). The compositions of the radial dikes vary from trachyte to augite-plagioclase lamprophyre; most are trachyandesite porphyries (Smith, 1977).

MINES AND PROSPECTS

History and production

All known workings in the study area are found in the zone of contact-metamorphosed sedimentary rocks surrounding the West Spanish Peak intrusive. Mineralized veinlets along a shear zone trending N. 65° E. have been worked in the Bulls Eye Mine on the north side of West Spanish Peak (fig. 2). Quartz veins bear argentiferous galena, tetrahedrite, chalcopyrite, and sphalerite, associated with siderite, calcite, and barite. Two mines on the eastern side and southeastern side of West Spanish Peak (here named "Mine 1" and "Mine 2," fig. 2), along with workings on several ridge tops, indicate areas of past mining activity. Vein material here is similar to that found at the Bulls Eye Mine (Kluender, 1983).

The total production prior to 1908 from the mines on West Spanish Peak was 168 oz of gold, 1,176 oz of silver, 92 lb of copper, and 1,067 lb of lead (Vanderwilt, 1947). Placer gold was reported by Hills (1901) from streams tributary to Wahatoya Creek and the Apishapa River. In 1932 and 1934, a few ounces of placer gold was produced from the north side of the study area. Four tons of lead-silver ore was shipped from the study area in 1934 and 1935 (Vanderwilt, 1947).

No workings are extensive, although at the Bulls Eye Mine the vein is traceable more than 0.5 mi along strike and about 2,000 ft vertically above the main workings. In the Bulls Eye Mine adit accessible at the time of this study, the vein is 6-12 in. wide; a vein sample taken at the face of the adit contained 0.026 oz/ton gold, 2.2 oz/ton silver, 2.28 percent lead, and 4.40 percent zinc (Kluender, 1983). Minor amounts of copper and antimony were also found in a few of the samples.

Mining and exploration activity

No active mining or exploration efforts were underway in 1982. Records and patented mining claims on the Bulls Eye Mine, Mine 1, and along two ridges on West Spanish Peak are filed with the U.S. Bureau of Land Management. There has been recent drilling for petroleum or for carbon dioxide just south of the study area boundary, in the Apishapa River drainage. Most of the land within the study area is currently under oil and gas lease application.

GEOCHEMICAL SURVEY

To assist the assessment of the mineral resource potential of the study area, a geochemical survey was made, utilizing stream-sediment, panned-concentrate, and rock samples. Each sample—rock, stream sediment sieved to less-than-80 mesh, and the nonmagnetic heavy-mineral fraction of the panned concentrate—was analyzed semiquantitatively for 31 elements using an optical emission spectrograph. Additional analyses for gold, bismuth, antimony, arsenic, zinc, and cadmium by atomic absorption and for uranium by fluorimetry were made on the rocks and stream sediments.

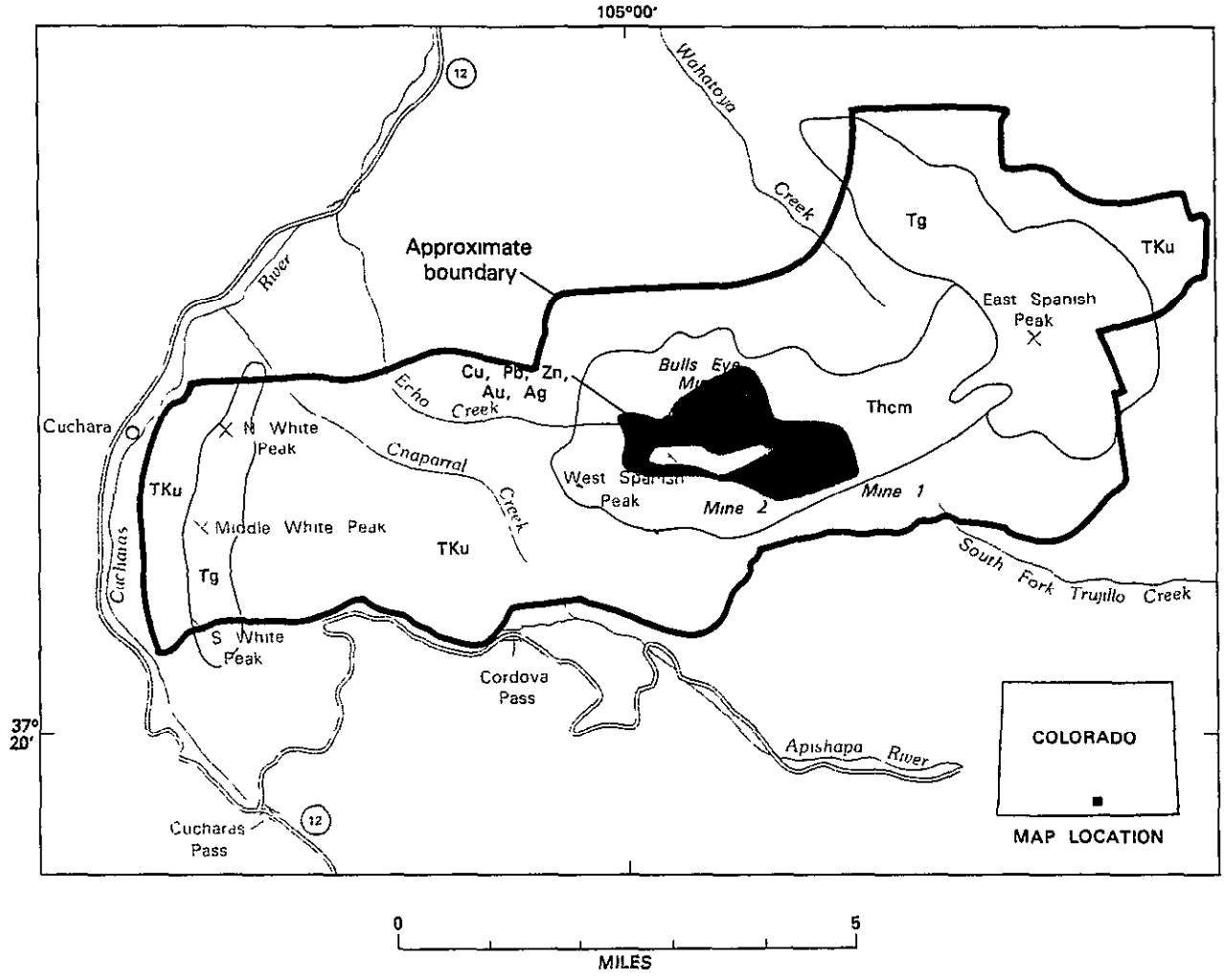
The majority of the geochemical anomalies were found in the vicinity of the old workings on West Spanish Peak. Table 1 describes the samples in the mineralized areas and lists their elements present in anomalous concentration—primarily lead, zinc, silver, copper, and minor gold. The rock samples that are not associated with the mines were collected from ridge tops in the northern and eastern parts of West Spanish Peak.

No gold was detected in the samples from tributaries to the Apishapa River and Wahatoya Creek, contrary to early reports by Hills (1901).

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mineralized areas in the study area are associated with veins in the aureole of metamorphosed sedimentary rocks surrounding the West Spanish Peak intrusive. The veins are present near the contact with the intrusive mass, and many are associated with shear zones. The mineralized veinlets are few and low in grade; therefore, a moderate potential for small deposits of lead, zinc, copper, silver, and gold is assigned to those areas proximal to the old workings and to other mineralized or anomalous areas as indicated in figure 2.

Most of the study area lacks significant anomalies related to metallic deposits. Coal may underlie the study area, but only at a depth of several thousand feet; therefore, it is a resource that has little likelihood of development. The oil and gas potential likewise appears low because of the apparent lack of structural traps and the igneous activity in the area.



EXPLANATION

Area having *moderate potential* for small deposits of lead, zinc, copper, silver, and gold

Cu	Copper
Au	Gold
Pb	Lead
Ag	Silver
Zn	Zinc

Ts	Syenodiorite (Tertiary)
Tg	Granite, granodiorite (Tertiary)
TKu	Undifferentiated sedimentary rocks (Tertiary and Cretaceous)
Thcm	Metasedimentary rocks (Tertiary)
	Contact

Figure 2.--Map showing area of mineral resource potential in the Spanish Peaks Wilderness Study Area, Huerfano and Las Animas Counties, Colo.

Table 1.—Chemically anomalous samples from West Spanish Peak

[Sample: SS, stream sediment; PC, panned concentrate; R, rock chip; X indicates anomalous concentration]

Sample no.	Ag	Bi	Cu	Mo	Ni	Pb	Zn	As	Au	Cd	Co	Sb	Sn	Sample description
SP-35-SS-----	X	X	X	X			X	X	X	X		X		From drainage directly below Bulls Eye Mine.
SP-35-PC-----						X								Do.
SP-37-SS-----						X	X	X		X	X			From larger drainage basin farther below Bulls Eye Mine.
SP-37-PC-----	X		X		X	X	X	X						Do.
SP-28-R------	X	X	X			X	X	X	X	X		X		Channel sample of vein gouge at Bulls Eye Mine.
SP-146-R-----	X	X				X	X	X	X	X		X		Gossan from prospect on ridge.
SP-539B-R----	X	X				X	X	X	X					From iron-stained shear zone in syenodiorite on ridge.
SP-559-R-----			X					X						Iron-stained syenodiorite containing sulfides, from ridge.
SP-122-R-----				X										Iron-stained syenodiorite from ridge.
SP-150-R-----									X					Hornfels containing sulfides, from ridge.
SP-524-SS,PC-							X							From drainage below Mine 1.
SP-158-R-----						X							X	Iron-stained hornfels containing pyrite boxwork, Mine 1.
SP-159-R-----	X		X				X	X		X				Sulfide-rich syenodiorite from dump below Mine 1.
SP-161-R-----	X		X			X	X	X		X				Iron-stained hornfels containing sulfides, from dump below Mine 1.
SP-52-SS,PC--							X							From drainage below Mine 2.
SP-162-R-----	X	X	X			X	X	X						Channel sample from Mine 2.
SP-164-R-----		X	X				X	X						Iron-stained, sulfide-rich rock and gossan from dump below Mine 2.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1628-A
PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE BUFFALO PEAKS WILDERNESS STUDY AREA, LAKE, PARK, AND CHAFFEE COUNTIES, COLORADO

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STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Buffalo Peaks Wilderness Study Area, Pike and San Isabel National Forests, Lake, Park, and Chaffee Counties, Colo. The area was established as a wilderness study area by Public Law 96-560, December 22, 1980.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

During 1981 and 1982, the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Buffalo Peaks Wilderness Study Area. The study area encompasses 57,200 acres (about 89 mi^2) of the Pike and San Isabel National Forests in Lake, Park, and Chaffee Counties, Colo.

There are six separate areas (A through F) having mineral resource potential. Area A, along the northeast margin of the study area has a moderate resource potential for silver in base-metal veins and bedded replacement deposits. Within area A a small zone near Weston Pass has a high potential for silver resources in veins. The northwest part of the study area (area B) has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. Area C is along the southwest margin of the study area, and has a low to moderate potential for silver and gold resources in quartz-pyrite veins. Most veins occur outside the study area. In addition, area C has low potential for uranium resources in veins. Area D has an identified uranium resource and a low to moderate potential for additional uranium resources in uraniferous jasperoids in the Sawatch Quartzite along the southeast margin of the study area. In the rest of area D there is a low to moderate resource potential for lead and barite in fault controlled deposits. Within area D a small zone along the northeast side of the Middle Fork of Salt Creek has a low to moderate resource potential for silver in vein deposits. Anomalous amounts of barium (2,000-10,000 ppm) and lead (30-1,500 ppm) were discovered by the geochemical sampling of stream sediments in areas E and F along the east margin of the study area. However, no bedded replacement or vein deposits of barite or galena were observed during geologic mapping, and therefore a low to moderate resource potential is assigned for barite and lead in areas E and F. The six mineralized areas are largely related to fault systems and to Laramide intrusive activity.

There is little or no indication of oil or gas, or geothermal energy resources in the study area.

INTRODUCTION

Location and geographic setting

The Buffalo Peaks Wilderness Study Area occupies 57,200 acres (about 89 mi^2) within the Pike and San Isabel National Forests in Lake, Park, and Chaffee Counties of Colorado (fig. 1). The study area is reached on the north by U.S. Forest Service road 425 along the South Fork of the South Platte River and over Weston Pass (altitude 11,921 ft) into Big Union Creek on the west. To the south, the study area is accessible from the Otero aqueduct line and the Lenhardy cutoff road. To the west, the Arkansas River and U.S. Highway 24 provide access to the Fourmile Forest Service Road 200 and the Buffalo Meadows

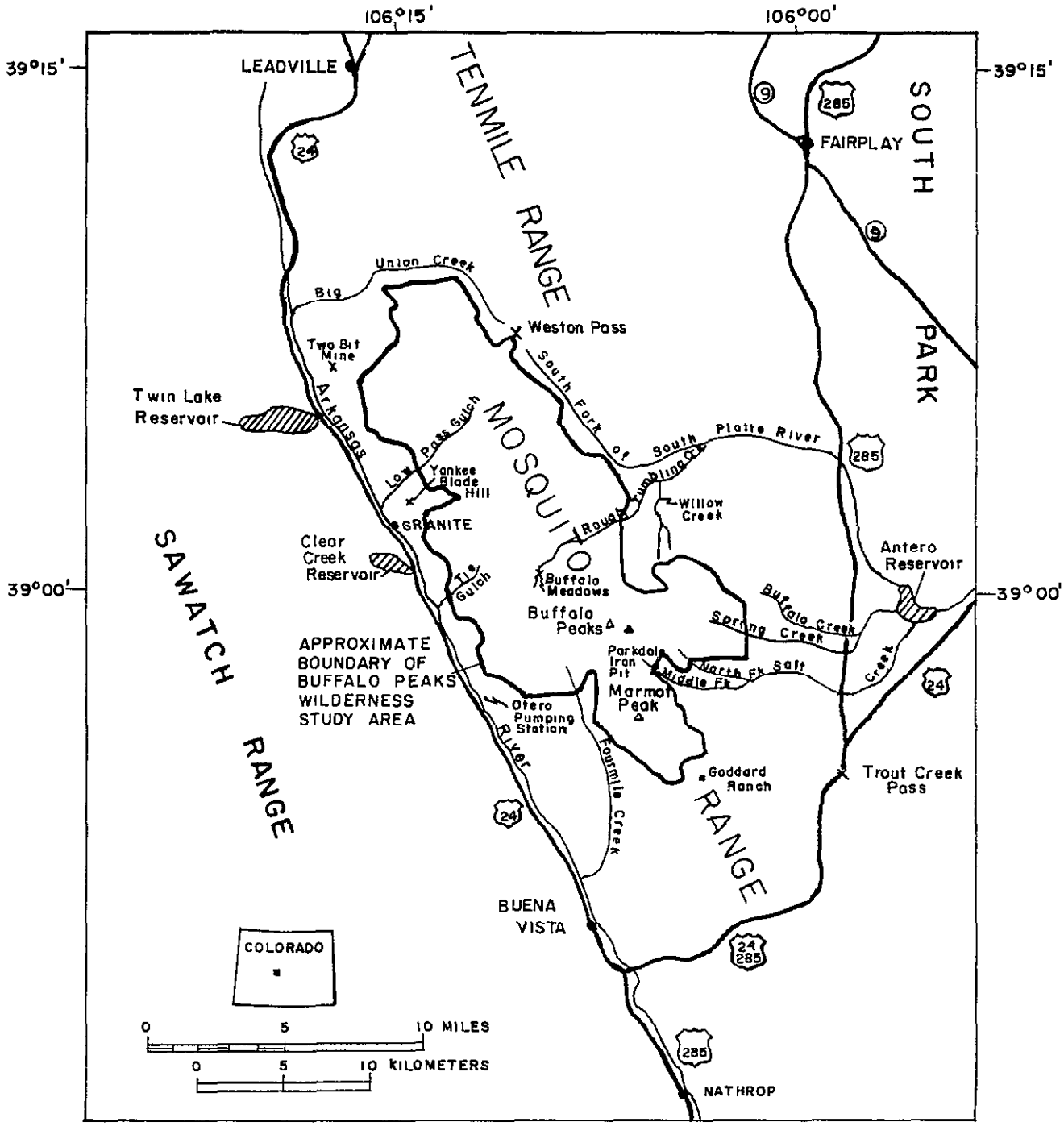

Figure 1.--Index map showing location of the Buffalo Peaks Wilderness Study Area.

trailhead along Fourmile Creek. The Low Pass Gulch road leading north from Granite and extending over Yankee Blade Hill into Hayden Gulch, provides access to the gold mines of the Granite district. On the east side of the Mosquito Range the numerous side roads such as the Buffalo Springs and Salt Creek roads that branch off from U.S. Highway 285 provide access to the southeastern part of the study area.

The study area is within the Mosquito Range, a major divide that separates the Arkansas River and its tributaries from South Park and the tributaries of the South Platte to the east. Elevations of peaks range from 12,892 ft on South Peak near Weston Pass to 13,326 ft on West Buffalo Peak. The Arkansas River valley, which is along a major rift structure that separates the Sawatch Range on the west from the Mosquito Range to the east, has elevations that range from 8,200 to 8,880 ft.

The Mosquito Range is located structurally on the N. 30° W.-striking east flank of the faulted Sawatch anticline (Tweto, 1975). The anticline has a core of Precambrian igneous and metamorphic rocks and an east flank of eroded Paleozoic strata. Paleozoic strata dip 25°-30° E.

Present and previous studies

Present investigations by the U.S. Geological Survey and the U.S. Bureau of Mines included mapping an area of about 125,000 acres in and around the study area. The U.S. Geological Survey investigations include geologic mapping at a scale of 1:50,000 (Hedlund, in press), an aeromagnetic survey (Hedlund, in press), and a geochemical sampling of rocks, stream sediments, and spring water (Nowlan and Gerstel, in press; Nowlan and others, in press). The U.S. Bureau of Mines has reviewed past and present mining activity, and the numerous mines and prospects of the study area were examined and sampled by Wood (1983). During the period of this study no actual mining was observed, although prospecting and claim staking activities in the vicinity of Weston Pass and along Union Gulch were noted.

Previous geologic studies in the study area include the reconnaissance maps by Tweto (1974) and Scott (1975); both maps are at a scale of 1:62,500. More detailed work includes the report on the geology of the Weston Pass mining district (Behre, 1932); a description of the gold veins in the Granite district by E. C. Eckel (unpub. data, 1932) and J. C. Hersey (unpub. data, 1982); and various maps and descriptions of the Salt Creek uraniferous jasperoids that were submitted to J. V. Dodge, owner of the Bronoc-Lady Elk claims by C. M. Armstrong (written commun., 1977, 1978) and Jack Di Marchi and Edward Duke (written commun., 1979). Production records for the Fourmile district are from Vanderwilt (1947). Radioactive mineral occurrences just south of the Buffalo Creek area and at the Josephine mines are reported by Nelson-Moore and others (1978).

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of J. C. Hersey of Gunnison, Colo., for providing the mining history and some of the production figures for various mines in the Granite district. We also thank J. V. Dodge of Canon City, Colo., for providing the mining history and reserve estimate for the Bronc-Lady Elk claims.

GEOLOGY

The Mosquito Range, which is continuous with the Tenmile Range north of Weston Pass, is a part of the N. 30° W.-striking east flank of the large, highly faulted Sawatch anticline (Tweto, 1975). Precambrian igneous and metamorphic rocks comprise the core of this anticline, and east-dipping Paleozoic strata along the east side of the Mosquito Range represent the eastern limb.

Precambrian rocks comprise a little more than three-fourths of the outcrop area and include older Proterozoic migmatite, amphibolite, and granodiorite group of rocks that is intruded by younger Proterozoic Y granitic rocks. The migmatite in the Granite district is probably part of a synformal structure having an axial plane that strikes N. 70° E. and shows closure to the west-southwest. The mineralized faults and rhyolite dikes within this migmatitic gneiss are approximately conformable to the foliation within the gneiss.

The Paleozoic strata include the Cambrian Sawatch Quartzite, about 150 ft thick; the Ordovician Manitou Dolomite, about 190-230 ft thick; the Ordovician Harding Sandstone, as much as 50 ft thick; the Ordovician Fremont Dolomite, about 90 ft thick; the Devonian and Lower Mississippian(?) Chaffee Group with an aggregate thickness of about 100 ft; the Lower Mississippian Leadville Limestone, about 140 ft thick; and the undivided Pennsylvanian Belden and Minturn Formations that are about 7,700 ft thick. Some formations are absent due to normal faulting, such as in the vicinity of Weston Pass, where the Ordovician Fremont Dolomite and beds of the Chaffee Group are absent. Numerous disconformities separate the lower Paleozoic formations; the Cambrian Sawatch Quartzite thins appreciably to the southeast of the study area and is absent through nondeposition or erosion in the vicinity of Trout Creek Pass. Similarly, the Ordovician Harding Sandstone thins northwest of Trout Creek Pass. Vuggy and locally silicified beds of the Mississippian Leadville Limestone are host for some of the bedded replacement ore bodies in the Weston Pass-Union Gulch districts. In places, the dolomitization of the Leadville Limestone to form 'zebra-striped' rock was probably an important factor for increasing porosity and providing sites for later ore deposition.

Laramide intrusions include a small biotitic rhyolite plug (61.4±2.2 m.y. old; dated by potassium-argon method) along the east side of Rough and Tumbling Creek and thin rhyolite dikes (65.3±2.4 m.y. old; dated by potassium-argon method) in the Granite district (R. F. Marvin and others, written commun., 1983). Other, and probably later intrusions of rhyolite dikes, in the vicinity of Fourmile Creek, are of Oligocene(?) age.

Deposits of Tertiary and Quaternary age include the thick (1,500-ft) sequence of Oligocene (34-m.y.-old) volcanic rocks in the Buffalo Peaks area, the Miocene and Pliocene Dry Union Formation and the diverse colluvium and glacial deposits of Quaternary age. The Buffalo Peaks Andesite overlies the crystal-rich ash-flow tuffs of the Oligocene Badger Creek

Tuff, but in places the ash-flow tuffs and associated laharic breccias are intercalated with the lower andesite flows.

Faults have had an important influence on the localization of mineral deposits. The silver-bearing base-metal veins of the Weston Pass-Union Gulch districts are along a branched fault system that is coextensive with the large Weston fault Some of these faults displace older northeast-striking faults that are not mineralized. The quartz-pyrite-gold-tourmaline veins of the Granite-Two Bit districts occupy closely spaced east-northeast-striking faults in migmatite. In area C (fig. 2), along both sides of Fourmile Creek, the quartz-pyrite-gold veins are coextensive with north-northwest-striking fault systems that show evidence of repeated movement. The uraniferous jasperoids at the Parkdale iron pit are probable hydrothermal vein and bedded replacement deposits that are localized along fractures and small faults in the Sawatch Quartzite and underlying Precambrian granite.

GEOCHEMISTRY

Geochemical sampling was done during June and July of 1982 (Nowlan and Gerstel, in press; Nowlan and others, in press). Sampling density was about one site per square mile. At each site, where possible, stream-sediment, stream-water, and two panned-concentrate samples were collected. Spring water was sampled where springs were encountered. Totals of about 80 stream-sediment samples, 160 panned concentrate samples, and 100 water samples were collected.

Stream-sediment samples were analyzed for 31 elements by emission spectrography (Grimes and Marranzino, 1968) and for arsenic, zinc, cadmium, bismuth, and antimony by a modification of the atomic-absorption-spectrographic method described by Viets (1978). Water samples were analyzed for about 25 constitutents using methods outlined by Ficklin and others (1981). One panned-concentrate sample from each site was panned until black minerals started to leave the pan: this concentrate was subjected to a series of heavy-mineral and electromagnetic separations in order to obtain a heavy, nonmagnetic fraction. The heavy, nonmagnetic sample was pulverized and analyzed for 31 elements by emission spectrography. A second concentrate from each site was panned until the light-colored, light-weight minerals were gone; the entire sample was then pulverized and a 10 g portion was analyzed for gold by atomic-absorption spectroscopy (Thompson and others, 1968).

Elemental values at the 90th percentile or greater are generally considered anomalous for the study area, and elemental values between the 75th and 90th percentiles are considered high (table 1). Some elements, such as silver, molybdenum, and tin in stream sediment or bismuth and vanadium in nonmagnetic heavy concentrates, were detectable in so few samples that any detectable amount is considered anomalous. Geochemical patterns are more significant than single-site, single-element anomalies. Elemental patterns that roughly coincide with areas of known mineralization are significant, especially if the elements giving the pattern are elements known to be part of the mineralization. The coincidence of patterns of many variables, even in areas of no known mineralization, is also significant. Nowlan and Gerstel (in press) summarized the geochemical associations and classified parts of the study area as being high or anomalous in various elements (see table 1 of their report).

Significant geochemical patterns are evident in five general areas (see table 2): Weston Pass-Union Gulch districts (area A, fig. 2); Granite-Two Bit districts (area B, fig. 2); Fourmile Creek-Buffalo Peaks districts (area C, fig. 2); southeastern part of the study area (areas D and E, fig. 2); and in the vicinity of the Laramide rhyolite stock between Rough and Tumbling and Willow Creeks (area F, fig. 2). Statistics for analyses of stream-sediment and panned-concentrate samples are shown in table 1 (this report).

The geochemical studies show that, in general, the geochemistry of various parts of the study area reflect known mineralization in adjacent areas outside the study area, even though elemental concentrations generally seem low for being adjacent to known mineralized areas. Stream-sediment samples from the Weston Pass-Union Gulch districts (area A, fig. 2) are anomalous in arsenic (>5 ppm), cadmium (>0.9 ppm), lead (>100 ppm), and zinc (>140 ppm); this anomaly is compatible with its proximity to the silver-bearing base-metal ores of the Weston Pass-Union Gulch districts.

Stream-sediment samples from the vicinity of the Granite-Two Bit districts (area B, fig. 2) have anomalous amounts of cadmium (>0.9 ppm), manganese (>1,500 ppm), nickel (>20 ppm), uranium (>21 ppm), and zinc (>140 ppm); panned concentrates from the vicinity of area B are anomalous in tungsten (>70 ppm). Stream-sediment and samples from the vicinity of area B are high in arsenic (5 ppm), copper (50 ppm), and lead (100 ppm); panned concentrates from the same area are high in boron (15-50 ppm), barium (500-1,500 ppm), manganese (1,000 ppm), lead (100-200 ppm), and thorium (300-700 ppm). Gold was chemically detected in several panned concentrates; the highest value is 0.95 ppm. This association of elements in samples from the Granite-Two Bit districts is compatible with the tourmaline-bearing quartz-pyrite-gold veins of the districts.

Stream-sediment samples for the Fourmile Creek-Buffalo Peaks districts (area C, fig. 2) have anomalous amounts of zinc (>140 ppm) and tin (detectable at 10 ppm). Panned concentrates from area C have anomalous amounts of copper (>14 ppm) and molybdenum (10 ppm). In addition, stream-sediment samples are high in copper (50 ppm), manganese (1,500 ppm), nickel (20 ppm), lead (100 ppm), and uranium (10-21 ppm). Panned concentrates from area C are high in manganese (1,000 ppm), lead (100-200 ppm), and thorium (300-700 ppm). Gold was chemically detected in several panned concentrates; the highest value is 1.0 ppm. The association is compatible with the high-temperature quartz-pyrite-gold veins along Fourmile Creek.

Area D (fig. 2) has uraniferous jasperoids and several silver-bearing veins. A pattern of anomalous boron (>50 ppm), molybdenum (10-20 ppm), lead (>200 ppm), and thorium (>700 ppm) in panned concentrates is present in an area that includes areas D and E (fig. 2). Stream-sediment samples from areas D and E and vicinity are high in copper (50 ppm), manganese (1,500 ppm), molybdenum (5 ppm or greater), nickel (20 ppm),

Table 1.--Statistics for analyses of stream-sediment and panned-concentrate samples from the Buffalo Peaks Wilderness Study Area, Colorado

[Leaders (---) indicate not applicable; dash (-) indicates value of zero; N, element not detected; L, element present in amount less than lower limit of determination; G, element present in amount greater than upper limit of determination; valid, number of unqualified values. Minimum, maximum, mean, and standard deviation are for the unqualified data]

Element	Minimum deviation	Maximum deviation	Mean deviation	Standard deviation	Number of samples			
					N	L	G	Valid
Stream sediments								
ppm								
Ag	3	3	3.000	---	84	-	-	1
As	5	10	5.770	1.8800	31	41	-	13
Ba	150	700	409.000	128.0000	-	-	-	85
Bi	2	2	2.000	.0000	5	51	-	29
Cd	.2	9	.661	.9760	-	-	-	85
Co	5	30	9.480	4.3800	-	-	-	85
Cu	10	70	28.100	11.3000	-	-	-	85
Mo	5	7	5.500	1.0000	81	-	-	4
Ni	5	30	14.000	7.3700	-	-	-	85
Pb	15	300	75.800	48.3000	-	-	-	85
Sn	10	30	20.000	14 1000	83	-	-	2
Th	200	500	150.000	104.0000	57	13	-	15
Zn	40	190	95.400	29 5000	-	-	-	85
Nonmagnetic panned concentrates								
percent								
Fe	.1	3	.315	.389	-	2	-	76
Mg	.05	5	.332	.715	-	20	-	58
Ca	3	30	11.800	6.660	-	-	-	78
Ti	.1	2	1.130	.637	-	-	18	60
B	20	150	38.400	32 700	52	7	-	19
Ba	50	10,000	724.000	1,790.000	-	5	1	72
Be	2	15	2.610	2.260	32	13	-	33
Bi	50	200	100.000	86.600	75	-	-	3
Co	10	70	17.800	17.100	61	1	-	16
Cr	20	200	53.000	32.300	1	7	-	70
Cu	10	30	13.300	5.880	36	27	-	15
La	100	2,000	987.000	613.000	-	-	8	70
Mn	200	2,000	699.000	370.000	-	-	-	78
Mo	10	150	31.300	48.500	68	2	-	8
Nb	50	100	59.500	13.600	30	28	-	20
Ni	10	30	17.500	7.070	70	-	-	8
Pb	20	1,500	142.000	263.000	-	-	-	78
Sc	15	50	22.700	5.450	-	-	-	78
Sn	20	70	35.000	17.200	53	7	-	18
Sr	200	1,500	600.000	394.000	61	-	-	17
Th	200	2,000	532.000	497.000	27	7	-	44
V	20	200	38.600	41.500	18	11	-	49
W	100	200	125.000	50.000	71	3	-	4
Y	200	2,000	877.000	390.000	-	-	-	78
Sr	2,000	2,000	2,000.000	.000	-	-	76	2
Raw panned concentrates								
ppm								
Au	.05	4.7	.820	1.420	67	1	-	10

Table 2.--Partial semiquantitative spectrographic analyses, fire assays, and atomic absorption analyses of selected samples from the Buffalo Peaks Wilderness Study Area, Colorado

[Source of data: USBM, U.S. Bureau of Mines; USGS U.S. Geological Survey, PID, released data from private industry; N.A., not analyzed, L, below limits of detection, -, not reported. Conversion factor 1 oz/ton = 34.3 g/t]

Locality No.	Source of data	Mine	Number of samples	Gold (oz/ton)	Gold (ppm)	Silver (oz/ton)	Silver (ppm)	Copper (ppm)	Lead (ppm)	Zinc (ppm)	eU_3O_8 (ppm)
Area A.	(Includes parts of the Weston Pass and Union Gulch districts)--Silver-bearing base-metal ores occur as bedding replacement and fissure vein deposits in chiefly the Leadville Limestone. Prior to 1916 the total Ag production is estimated at about 125,000 oz of which over half was from the Ruby-Cincinnati group of mines. Some veins were especially in Zn and Pb but the production figures for these metals are not known. There has been very little mining in these districts since 1918.										
2	USGS----	Ruby-Cincinnati group	2	-	L	-	5	300	5,000	7,000	N.A.
				-	L	-	50	300	70,000	30,000	N.A.
2	--do----	Collin-Campbell-------	1	-	L	-	15	100	15,000	15,000	N.A.
2, 3, 4, 5.	USBM----	Weston Pass mines-----	11 (average)	<0.005	-	<0.2-0.5	-	50	240	N.A.	N.A.
6, 7, 8	--do----	Union Gulch mines-----	22 (average)	<.005	-	<.2-.5	-	70	270	N.A.	N.A.
1	USGS----	Mines near Rich Creek Campground.	1	-	L	-	L	7	50	200	N.A.
1	USBM----	----do----------	8 (average)	<.005	-	<.2	-	40	N.A.	N.A.	N.A.
Area B.	(Includes parts of the Granite--Two Bit districts)--Au placers were discovered in the vicinity of Granite in 1859 and the quartz-pyrite-gold veins on Yankee Blade Hill in the early 1860's. The total production value prior to 1878 has been variously estimated at about $750,000 (E. B. Eckel, unpub. data, 1932) to $2,000,000 (J. C. Hersey, written commun., 1982). Probably the best production figure ranges from 65,000 to 97,000 oz of Au. Most of the Au came from the mines on Yankee Blade Hill and from the mines north of Low Pass Gulch (Belle of Granite mine). Au production after 1880 was insignificant.										
11	USGS----	Two Bit mine dump-----	1	-	0.45	-	100	1,500	700	500	N.A.
12	--do----	Two Bit mine extension (trench).	1	-	.10	-	10	200	700	500	N.A.
11, 12	USBM----	Two Bit Gulch district mines.	11 (average)	<.005	-	<.2-.8	-	60	120	N.A.	N.A.
4	USGS----	Granite tunnel dump-	1	-	1.7	-	.15	200	200	L	N.A.
4	USBM----	----do----------	14 (average)	<.005	-	<.2	-	50	150	40	N.A.
4	--do----	----do----------	9 (average)	.201	-	.08	-	170	2,500	850	N.A.
3	PID-----	Diverse (4) mines of Yankee Blade Hill.	18 (average)	1.74	-	.8	-	280	590	560	N.A.
3	USBM----	Diverse mines of Yankee Blade Hill.	35 (average)	<.005-.254	-	<.2-1.3	-	100	160	N.A.	N.A.
3		Mine 114 (Wood)-------	1	.31	-	.4	-	N.A.	N.A.	N.A.	N.A.
6	USGS----	The Belle of Granite mine dump.	1	-	1.0	-	2.0	500	500	500	N.A.

7	--do----	Mine No. 4----------	1	-	.5	-	L	15	70	L	N.A.
5	USBM----	Free Gold, Yosemite, Hattie Jane.	33 (average)	<.005-10	-	<.2-.3	-	140	160	N.A.	N.A
8	--do----	Mines of Spring Creek	14 (average)	<.005-.5	-	<.2-.5	-	80	20	N.A.	N.A.
9	--do----	Mines of upper Low Pass Gulch.	5 (average)	<.005	-	<.2	-	80	100	N.A.	N.A.
10	--do----	----do----------	1	<.005	-	<.2	-	100	100	N.A.	N.A.
		Mines in Tie Gulch									
1, 2	--do----	Unknown----------	5 (average)	<.005-.016	-	<.2-.2	-	25	N.A.	N.A.	N.A.

Area C. (Includes parts of the Fourmile and Buffalo Peaks mining districts)--The quartz-pyrite-gold veins along Fourmile Creek and extending to the Arkansas River have been extensively explored but most deposits are small and have yielded only small amounts of Au. The Little Annie group of mines probably produced 53 oz of Au from 1935 through 1937 and 39 oz of Ag in 1940 (Vanderwilt, 1947, p. 45). The other mines in the district are relatively small, although there has been extensive exploration along the quartz veins of the Bonanza-Midway claims.

5, 6	--do----	Josephine mines-------	8	<.005	-	<.2-.2	-	80	N.A.	N.A.	1, 2, 6, 1, 3.
2	USGS----	Divines Gusto No. 1---	1	-	.25	-	L	L	L	L	N.A.
4	--do----	Little Annie mine-----	1	-	L	-	L	20	70	L	N.A.
4	USBM----	Little Annie mine group.	15	<.005-.396	-	<.2	-	30	N.A.	200	N.A.
1	USGS----	Bonanza-Midway claims	1	-	L	-	L	2	50	L	N.A.
1	USBM----	----do----------	17	<.005-.058	-	<.2	-	45	N.A.	N.A.	N.A.

Area D. (Salt Creek area uranium)--Mineral occurrences within the Salt Creek area of the Fourmile and Buffalo Peaks mining districts. U was first discovered by J. Amrine in the mid-1950's at the Parkdale iron pit near the head of Middle Fork of Salt Creek. The U is in a vuggy jasperized ironstone and in jasperized breccias that probably formed by hot spring activity. As much as 52 tons of uraniferous jasperoid was shipped to a mill at Rifle, Colo. This ore shipment averaged in excess of 0.1 percent U_3O_8. No other work was done on the property until 1976 when J. V. Dodge of Canon City, Colo., acquired the property and began a detailed study of the prospect. As a result of this work (2,805 ft of rotary drill cuttings, geophysical studies, and an open pit) an estimated resource of 4,000 tons per vertical foot of U ore averaging 0.04-0.05 percent U_3O_8 was established in an area of 1,200 by 40 ft at the Parkdale iron pit. The thickness of this deposit is at least 3-4 ft as indicated by test pits and trenches.

1	USGS----	Parkdale Iron Pit-----	2	-	L	-	L	5	30	2,000	287, 288
				-	L	-	L	L	50	3,000	
1	USBM----	Parkdale iron pit and other prospects.	12	<.005	-	<.2-.3	-	55	135	1,300	135, 36, 241, 243.
4	--do----	Prospects of Middle Fork of Salt Creek.	7	<.005	-	<.2-.5	-	60	N.A.	N.A.	N.A.

and zinc (120-140 ppm). Panned concentrates from areas D and E and vicinity are high in boron (15-50 ppm) and manganese (1,000 ppm). Uranium is uniformly present in amounts less than the 75th percentile (<0.5 ppm) in stream-sediment samples from areas D and E, but water samples from area E are anomalous in uranium (1.5-6.8 micrograms per liter).

Two geochemical anomalies are present where there is little or no evidence of mining activity. Panned concentrates from area F (fig. 2), in the vicinity of the Laramide rhyolite stock between Rough and Tumbling and Willow Creeks, have anomalous amounts of barium (as much as 10,000 ppm) and lead (as much as 1,500 ppm). The panned concentrates are also anomalous in chromium (>70 ppm), iron (>0.5 percent), magnesium (>0.5 percent), molybdenum (>30 ppm), niobium (>50 ppm), tin (>30 ppm), strontium (>500 ppm), thorium (>700 ppm), titanium (>2 percent), and tungsten (>100 ppm). Stream-sediment samples from area F are anomalous in uranium (>21 ppm). In addition, stream-sediment samples from area F are high in arsenic (5 ppm), cadmium (0.68-0.92 ppm), manganese (1,500 ppm), nickel (20 ppm), and zinc (120-140 ppm); panned concentrates from area F are high in boron (15-50 ppm), calcium (15 percent), copper (10 ppm), and manganese (1,000 ppm). Water samples from some springs and streams around the stock are highly anomalous (Nowlan and others, in press). The waters contain concentrations of sulfate as high as 1,000 mg/l, copper as high as 14 μg/l, molybdenum as high as 15 μg/l, cobalt as high as 10 μg/l, and nickel as high as 1,500 μg/l.

The other geochemical anomaly in an area of little or no past or present mining activity is in Buffalo Meadows (fig. 2) where molybdenum (30-150 ppm) and tungsten (100 ppm) in panned concentrates are anomalous. The highest amount of gold in any sample from this study (4.7 ppm or about 0.13 oz/ton) was found in panned concentrate from Buffalo Meadows. This geochemical anomaly is near a north-northwest-striking fault in granite. Isolated anomalous values occur throughout the study area, but the coincidence of high gold, molybdenum, and tungsten in panned concentrates from Buffalo Meadows is probably the isolated anomaly of most consequence.

In the vicinities of areas D, E, and F (fig. 2) are several areas of anomalous barium (2,000-10,000 ppm) and lead (30-1,500 ppm) values in panned concentrates. The barium and lead anomalies occur along or near faulted outcrops of the Belden and Minturn Formations. The silver values are low, less than 1 ppm. No barite deposits were verified by geologic mapping.

GEOPHYSICS

A residual aeromagnetic map (Hedlund, in press) is derived from the U.S. Geological Survey aeromagnetic map (1982) that is published at a scale of 1:62,500. The survey was flown at an elevation of 1,000 ft above ground along northeast-southwest oriented flight lines spaced 0.5 mi apart.

The aeromagnetic map shows the magnetic expression of some of the major rock types in the study area. For example, an arcuate magnetic low of -103 to -253 gammas occurs over the migmatite in the Granite district and a similar magnetic low of +9 to -129 gammas occurs over the migmatite of the Goddard Ranch area. Low gamma values are also observed over the Paleozoic strata and Cenozoic valley-fill deposits. Strong positive anomalies of as much as +400 and +570 gammas occur over Precambrian dioritic intrusions and the magnetite-enriched parts of the Silver Plume granitic rocks at the higher elevations. The rhyolite stock near the mouth of Rough and Tumbling Creek has no magnetic expression. Sharply defined, closed, negative anomalies are locally paired with small positive anomalies over the basaltic andesite flows of West and East Buffalo Peaks. These dipoles probably indicate the presence of negatively polarized flows in this area.

The aeromagnetic survey did not indicate the presence of any hidden mineralized areas. Many of the magnetic anomalies were checked on the ground with a Scintrex SM-5[1] magnetometer, but the ground survey failed to reveal any correlation with alteration zones or igneous plutons of possible Laramide age.

MINING DISTRICTS AND MINERALIZED AREAS

Six areas having mineral resource potential (A-F) have been delineated in the Buffalo Peaks Wilderness Study Area (fig. 2) These areas do not necessarily correspond to specific mining districts but do encompass areas of similar mineralization. The study area is within, or adjacent to parts of the following mining districts: Weston Pass, Granite, Buffalo Peaks, Fourmile, Two Bit, and Union Gulch (Henderson, 1926). There are no active mines within the study area, but about 2,000 acres of the Buffalo Peaks Wilderness Study Area are covered by mining claims on file with the U S. Bureau of Land Management (Wood, 1983). Table 3 summarizes information about mines and prospects in the study area. The various mineral resources within the described areas are discussed in order from A to F and not necessarily in order of decreasing mineral potential.

Weston Pass-Union Gulch districts (includes area A)

The silver-bearing base-metal veins of this area (fig. 2) are along the Weston fault zone that extends southeast along the South Fork of the South Platte River at the northeast margin of the study area. This fault zone, of probable Laramide and Pliocene-Miocene age, includes the Weston-Buffalo Creek faults, numerous branches of the Weston fault, and an older east-northeast-trending fault system. Area A extends southeast to workings about 0.5 mi south of Rich Creek Campground.

The Weston Pass-Union Gulch districts were active from 1890 to 1902 with a brief period of renewed mining during World War I. It is estimated that the past production value of $125,000 for the Weston Pass district is equivalent to about 125,000 oz of silver; the value of the base metals is not known. The Ruby-Cincinnati Group of mines was the leading producer (about 30,000 oz of silver) followed by the Gates, Collin Campbell, and Payrock mines. Most of the production came from oxidized ore bodies in the

[1]The use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey

zone of supergene enrichment, generally at depths of less than 300 ft (Behre, 1932). Cerussite, anglesite, smithsonite, and hemimorphite were common minerals in this oxidized zone that also contained cerargyrite and native silver(?). The enriched silver ores from the Ruby-Cincinnati mine averaged about 15 oz of silver per ton, but some rich pockets at the Payrock mine contained as much as 35 oz of silver per ton (Behre, 1932). Many of the enriched supergene ore bodies have been exhausted, most mines are now caved or flooded, and the protores have only 0.1-0.5 oz of silver per ton.

The ore minerals occur as disseminations, vug fillings, and bedded replacement bodies within brown, silicified fault breccias chiefly within the Leadville Limestone but also in the Manitou Dolomite. Most faults strike N. 30°-40° W. and dip 20°-55° NE; underground, overturning of the beds and thrust faulting was observed by Behre (1932, p. 62). Some of the silicified shatter zones are as much as 8 ft wide. The hypogene ore minerals included sphalerite, argentiferous galena, traces of chalcopyrite, and probably arsenpolybasite. Ores from the Ruby Tunnel contain as much as 1,500 ppm arsenic that is concentrated in a silver-bearing sulfosalt, such as the pearceite-polybasite group. Some of the sphalerite-rich ores contain as much as 70 ppm cadmium.

In summary, the northwest-striking faults of the Weston fault system are favorable sites for further exploration, especially where they intersect older northeast-striking faults and carbonate strata.

Granite-Two Bit districts (includes area B)

The mines within area B were among the earliest producers of gold in Colorado. Placer gold was discovered near Granite in 1859 and the vein deposits on Yankee Blade Hill were exploited in the early 1860's. Most of the lode mines were developed to depths of 100-380 ft in the oxidized parts of the vein systems, and the veins were worked almost continuously from about 1862 to about 1878. Thereafter, the rich lead and silver discoveries at Leadville drew most of the mining activity away from Granite. In 1908, the Granite Tunnel Company was organized and work began on a tunnel driven south from Low Pass Gulch in order to develop the veins of Yankee Blade Hill to a greater depth. The veins persisted to depths of 500-800 ft below ground level, and as many as 19 veins were cut by the adit over a distance of 2,054 ft (J. C. Hersey, written commun., 1982). Numerous samples taken during this exploratory work indicated an average gold content of about 2 oz/ton, but some ore shoots averaged a much higher grade.

The total past production figures are largely estimates and range from about 65,000 to 97,000 oz of gold. Most of this production came from Yankee Blade Hill and from the Belle of the Granite mines between 1862 and 1878. The following table shows a breakdown of the production figures for the principal mines in the Granite district.

The quartz-pyrite-gold veins are steeply dipping and strike predominantly N. 70°-80° E. within the Precambrian migmatite. The veins are slightly discordant to the foliation in the migmatite and occur in swarms on Yankee Blade Hill and there are as many as 19 veins in a 2,054-ft interval. Some veins are as much as 3,000 ft long, 1-3 ft wide, but show numerous pinchouts along the strike. A few veins extend eastward into the study area but most are outside, within 1 mi of the boundary. The gneissic and migmatized wallrocks are commonly silicified adjacent to the veins but the outer envelope is commonly altered to chlorite and sericite. The veins have a relatively simple mineralogy and have appreciable amounts of pyrite but minor amounts of galena (lead, about 900 ppm), sphalerite (zinc, about 650 ppm), and chalcopyrite (copper, about 280 ppm). The gold to silver ratio is about 2.5:1 and the silver values range from about 0.7 oz/ton to about 0.64 oz/ton. The gold values are highly variable and range from 0.005 to 10 oz/ton; most veins from Yankee Blade Hill average about 1.7 oz/ton. Boron geochemical anomalies (50-200 ppm) are associated with many of the veins and indicate the presence of tourmaline in many of the deposits.

Mine	Estimated ounces (troy) of gold produced
Yankee Blade	23,000
The Belle of Granite	24,000
Magenta	9,600
Robert George	4,800
New Year	3,800
Bunker Hill	3,300
Washington	2,800
D.C.C.	1,200
Gopher	960
California	380
Yosemite-Keystone	350
B and B	400
Hattie Jane	46
Total	64,635

The quartz-pyrite-gold veins are probably related to the intrusion of east-northeast-striking rhyolite dikes during the Laramide orogeny (potassium-argon age of dikes is 65.3±2.4 m.y., R. F. Marvin and others, written commun., 1983). At the Yosemite-Keystone mine, a rhyolite dike locally forms the south footwall of the vein, and about 2,200 ft south of the Belle of Granite mine a rhyolite dike contains partially oxidized pyrite cubes a few millimeters across. In the vicinity of the silver-bearing veins at the Two Bit mine, a thin rhyolite dike is sheared along a vein, thus suggesting some postdike mineralization.

In summary, the quartz-pyrite-gold veins of the Granite district, which is adjacent to the study area, are characterized by intensive silicic and chloritic wallrock alteration, the presence of anomalous boron, a relatively low base-metal content, a gold to silver ratio of 2.5:1, and a spatial association with rhyolite dikes. The gold content of the veins varies from 0.005 to about 2 oz/ton, whereas the silver values range from about 0.07 to about 0.64 oz/ton. The quartz-pyrite-gold veins crop out mainly within migmatitic gneiss in the Granite district, chiefly outside of the study area.

Table 3.--Mineral deposits and mineral occurrences of the Buffalo Peaks Wilderness Study Area, Colorado

[Prospect or mine number corresponds with locality shown on map. All prospects and mines within the study area were inactive at the time of fieldwork in 1981 and 1982. Au, gold, Ag, silver, Cu, copper, Pb, lead, Zn, zinc, U, uranium. Conversion factor. 1 oz/ton = 34.3 g/t]

Prospect No.	Name	Commodity	Development	Geology	Production	Reference
Area A.	(Includes parts of the Weston Pass and Union Gulch districts)--Silver-bearing base metal ores occur as bedding replacement and fissure vein deposits in chiefly the Leadville Limestone Prior to 1916 the total silver production is estimated at about 125,000 oz of which over half was from the Ruby-Cincinnati group of mines. Some veins were especially rich in Zn and Pb but the production figures for these metals are not known. There has been very little mining in these districts since 1918.					
1	Mines near Rich Creek Campground	Ag, Zn--	Several shafts and numerous prospect pits.	Highly jasperized fault breccias that strike N. 60°-65° E. are displaced by a series of small N. 50° W.-striking fractures and faults. The northwest fractures are weakly mineralized and contain as much as 200 ppm Zn.	Unknown----------	None.
2	Ruby-Cincinnati group	Ag, Zn Pb.	Incline, shafts, and numerous prospect pits. Over 1,400 ft of workings.	Ore in discontinuous masses in vuggy, jasperized zones within limestone beds. Ores localized along northwest-trending Weston fault zone.	Oxidized ore in zone of supergene enrichment yielded about 3,000 tons of ore. Grade varied from 0 2 to 15 oz of Ag per ton. Production was valued at about $100,000.	Behre (1932, p. 69-70, 73); Chapman and Stephens (19..., p. 207).
2	Collin-Campbell mine.	--do----	Shaft about 300 ft deep.	Ore bodies in silicified breccia zones within limestone.	Three to four carloads of ore valued at about $20,000.	Behre (1932, p. 70, 73).
3	Mines of the Gates claim.	--do----	Shafts and prospects----	Oxidized sphalerite, galena, and silver sulpho-arsenides along northwest-striking fissure veins. Some ore bodies enriched with sphalerite.	Probably small----------	Behre (1932, p. 71, 73).
4	Payrock group of mines.	--do----	Several small shafts and tunnels.	Ag-bearing base-metal sulfides along N. 30°-35° W.-striking fault.	Unknown, probably small----------	Behre (1932, p. 71).
5	Unknown----------	--do----	Several prospect pits.	Small gossan and jasperized vein----------	Insignificant.	
6	----do----------	--do----	Two adits trend N. 80° E. into Weston fault.	Small amounts of pyrite in Belden shales---------	Unknown----------	None.
7	----do----------	--do----	Trench and fault------	Sparse amounts of sulfides along N. 20° E.-striking fault breccia. Small silicified gossan zone.	----do----------	Do.
8	----do----------	--do----	Caved adit trends S. 60° E.	Sparse amounts of sulfides along northeast striking fault.	----do----------	Do.
Area B.	(Includes parts of the Granite and Two Bit districts)--Au placers were discovered in the vicinity of Granite in 1859 and the quartz-pyrite-gold veins on Yankee Blade Hill in the early 1860's. The total production value prior to 1878 has been variously estimated at about $750,000 (E B. Eckel, unpub. data, 1932) to $2,000,000 (J. C Hersey, written commun., 1982). Probably the best production figure ranges from 65,000 to 97,000 oz of Au. Most of the Au came from the mines on Yankee Blade Hill and from the mines north of Low Pass Gulch (Belle of Granite mine). Au production after 1880 was insignificant.					
1	B and B mine-------	Au, Ag--	Two inclined shafts-----	Quartz-pyrite-Au vein within granite apophysis in migmatite. Vein strikes east-northeast and can be traced for about 700 ft	Past Au production small, about 400 oz.	E. B Eckel (unpub. data, 1932).
2	Unknown----------	--do----	Shaft and series of four shallow pits aline N. 70° E.	Quartz-pyrite-Au vein near intersection with N. 20° W.-striking fault.	Probably negligible----------	Do.

3	Yankee Blade group, including the Yankee Blade, Magenta, Robert George, New Year, Washington, Gopher, California and other smaller mines.	--do----	Numerous shafts, tunnels, adits, and prospects many of which are caved. At least eight mines have had production.	A closely spaced series of about 18 quartz-pyrite-Au-tourmaline veins that strike east-northeast. Intense silicification and chloritization of the wallrocks, chiefly migmatite. Appreciable supergene enrichment of the Au. Minor amounts of chalcopyrite, galena, and sphalerite	Estimated Au production is as follows Yankee Blade (23,000 oz), Magenta (9,600 oz), Robert George (4,800 oz), New Year (3,800 oz), Bunker (3,300 oz), Washington (2,800 oz, Gopher (960 oz), and California (380 oz).	E. B. Eckel (unpub data, 1932), J C. Hersey, (unpub data, 1982).
4	Granite tunnel----	--do----	Tunnel trends S. 55° E. and is about 2,054 ft long.	Tunnel intersects as many as 18 veins on Yankee Blade Hill. Native Au occurs in vuggy quartz veins in association with minor sphalerite, galena, and chalcopyrite. Pyrite is relatively common. Many east-northeast-striking veins persist over a length of about 2,000 ft but show branching and pinch-outs along strike	Tunnel was driven to drain and consolidate the old shallow mines on Yankee Blade Hill and to explore various veins and ore shoots below the old mines at a depth of 500-800 ft. The Granite Tunnel Company was organized in 1908.	Do.
5	Yosemite-Keystone, Hattie Jane, and Free Gold mines	--do----	Yosemite (two caved adits and small prospect pits), Hattie Jane (several small pits and a 36-ft shaft), Free Gold (adit about 400 ft long.	Quartz-pyrite-Au veins along east-northeast-striking fissure veins in migmatite. Abundant limonite along some of the veins.	Yosemite mine has produced about 530 oz of Au in the 1930's The Hattie about 46 oz of Au and 8 oz of Ag Production from the Free Gold mine is unknown but probably small.	E 8. Eckel (unpub. data, 1932)
6	The Belle of Granite.	--do----	Developed by 450-ft-deep shaft with six levels and over 3,000 ft of workings.	Quartz-pyrite-Au vein 16 in to 5 ft wide strikes east-northeast in migmatite Abundant pyrite but minor amounts of sphalerite and galena Vein is about 1,000 ft long	Production prior to 1912 was about 24,000 oz of Au valued at $500,000	E B Eckel (unpub. data, 1932), J C Hersey, (unpub data, 1982)
7	"Mine No. 4"------	--do----	Shaft----------	Quartz-pyrite-Au vein strikes east-northeast within migmatite. Small gossan has yielded about 0 015 oz of Au per ton	Unknown----------	None
8	Mines of Spring Creek.	--do----	Numerous prospect pits and small adits.	Quartz-pyrite-Au veins that strike east-northeast.	----do----------	Do
9	Unknown, mines of upper Low Pass Gulch.	--do----	Small adits and prospect pits	Quartz-pyrite-Au vein strikes N. 40° W in granite. Minor sphalerite and galena	Unknown----------	Do
10	Unknown, mines of Low Pass Gulch.	--do----	Trench and prospect pits.	Reddened quartz vein in granite is only a few inches thick Vein strikes N 20° W. and is about 15-20 ft long. Radioactivity is about two times background. Some smoky quartz	No production----------	Do
11	Two Bit mine------	Ag, Au--	Shaft----------	Ag-bearing base-metal vein strikes N. 75° E. Minor amounts of chalcopyrite, galena, and sphalerite in dump. Chloritized granite wallrock. The presence of 300 ppm antimony in analyzed samples suggests the presence of Ag sulfosulfosalts. As much as 100 ppm Ag in some vein material.	Unknown----------	Do
12	Two Bit extension.	--do----	Trench and caved incline.	Abundant manganese oxides along quartz vein in granite. Vein strikes N. 65° E. and locally follows faulted rhyolite dike. Traces of sphalerite and chrysocolla.	----do----------	Do
				Mines in Tie Gulch		
1	Unknown----------	Au, Ag--	Two shafts and adit-----	Limonite-stained quartz veins along northwest-striking fault. Trace of Au and Sg.	----do----------	Do
2	----do----------	--do----	Shaft and adit----------	----do----------	----do----------	Do.

Table 3.--Mineral deposits and mineral occurrences of the Buffalo Peaks Wilderness Study Area, Colorado--Continued

Prospect No.	Name	Commodity	Development	Geology	Production	References
Area C	(Includes parts of the Fourmile and Buffalo Peaks mining districts)--The quartz-pyrite-Au veins along Fourmile Creek and extending to the Arkansas River have been extensively explored but most deposits are small and have yielded only small amounts of Au. The Little Annie group of mines probably produced 53 oz of Au from 1935 through 1937 and 39 oz of Ag in 1940 (Vanderwilt, 1947, p. 45). The other mines in the district are relatively small, although there has been extensive exploration along the quartz veins of the Bonanza-Midway claims.					
1	Bonanza-Midway claims	Au-----	Numerous shafts and prospect pits.	Several quartz veins that strike northwest are persistent over a length of about 3,000 ft. Veins are as much as 3 ft thick and dip steeply to the southwest. Some veins are highly brecciated with hematitic alteration.	Unknown----------	Do.
2	Divines Gusti No. 1	--do----	Small incline trending N 40° W.	Small gossan in migmatite within granite, altered zone is about 3 ft wide, strikes N. 70° E. and dips 25°-30° N.	----do----------	Do.
3	Unknown----------	--do----	Two prospect pits------	Quartz-pyrite-Au vein strikes northwest in chloritized granite. Quartz vein poorly exposed.	----do----------	Do.
4	Little Annie mine group	Au, Ag, Cu, Pb, Zn	Two caved adits and numerous prospect pits	Quartz-pyrite-Au veins in granite strike northwest. Sparse amounts of magnetite, barite, amethyst quartz, and manganese oxide gangue.	Production small, about 53 oz of Au between 1935 and 1937 and 39 oz of Ag in 1940.	Vanderwilt (1947, p 45)
5	Josephine mine---	U, Au---	Shaft, tunnel about 305 ft long, and numerous prospect pits, mines caved during construction of Otero pumping station	Quartz pyrite vein strikes west-northwest and is about 800 ft long Slightly radioactive, about twice background. Samples show 1-6 ppm U_3O_8 (table 2).	Unknown----------	Nelson-Moore and others (1978)
6	----do-----	U-------	Shafts, opencuts, trenches	Peridotite porphyry dikes at contact with granite are radioactive. Dikes strike N 20° W. and locally contain abundant granite xenoliths.	----do----------	None
7	Unknown (Frost Mining Co claims)	Au------	Over 850 ft of trenching and a 125-ft adit	Small northwest-trending shear in diorite stock. No visible Au. Probable source for Au placer operation at mouth of Buffalo Creek. This placer claim (Amanda Ann) covers 13 8 acres	----do----------	Do.
Area D	(Salt Creek area uranium)--Mineral occurrences within the Salt Creek area of the Fourmile and Buffalo Peaks mining districts U was first discovered by Armire in the mid-1950' at the Parkdale iron pit near the head of Middle Fork of Salt Creek The U is in a vuggy jasperized ironstone and in jasperized breccias that probably formed by hot spring activity. As much as 52 tons of uraniferous jasperoid was shipped to a mill at Rifle, Colo This ore shipment averaged in excess of 0 1 percent U_3O_8. No other work was done on the property until 1976 when J. V Dodge of Canon City, Colo , acquired the property and began a detailed study of the prospect As a result of this work (2,805 ft of rotary drill cuttings, geophysical studies, and an open pit) an estimated resource of 4,000 tons per vertical foot of U ore averaging 0 04-0 05 percent U_3O_8 was established in an area of 1,200 by 40 ft at the Parkdale iron pit. The thickness of this deposit is at least 3-4 ft as indicated by test pits and trenches.					
1	Parkdale iron pit of the Bronco claims	U, Zn---	Open pit, trenches and numerous prospect pits.	Vuggy jasperoid with opaline-quartz vug linings Various samples have assayed 243, 400, 241, 287, 135, 80, and 36 ppm U_3O_8 and 0.2, 0.3 and 0.13 percent Zn. The thorium content is only 13 ppm. The extent of the mineralized ground is only tentative owing to the soil cover.	About 52 tons of uranium ore----	C. M Armstrong (unpub data, 1977), Jack DiMarchi and Edward Duke (unpub data, 1979)
2	COMINCO property---	U, Pb, Zn.	Two trenches and numerous prospect pits	Vuggy jasperoid developed in the Manitou Dolomite No appreciable radioactivity but nearby granite has 80 ppm equivalent U and is more radioactive than the jasperoids.	No production----------	None
3	Unknown----------	Ag, Zn Pb.	Dozer cut, shaft and prospect pit.	Gossan along northeast-striking fault Cherty dolomite of the Manitou is slightly pyritized and altered.	Negligible----------	Do.
4	----do----------	Ag------	Trench, shafts, and numerous prospect pits.	Slightly mineralized northwest-striking fault within the Belden Formation. A few analyses indicate a maximum of about 0.5 oz of Ag per ton.	----do----------	Do

[1]Occurrence inside the wilderness.

Fourmile-Buffalo Peaks districts (includes area C)

The quartz-pyrite-gold veins of this area are localized along north-northwest-striking faults that extend from Marmot Peak westward to the Arkansas River and northward to Buffalo Creek; the southern limit is not shown (fig. 2). Most of these veins extend less than 2 mi outside of the study area.

Production records are mainly from Vanderwilt (1947, p. 45). Because the largest mine in the Fourmile district is the Little Annie, and most prospects are small, it is inferred that the production figures cited by Vanderwilt are for the Little Annie mine. The Little Annie mine operated from 1935 through 1937 and produced about 78 tons of ore yielding 53.5 oz of gold. In 1940, the operation was renewed but the production figures are unknown.

The quartz-pyrite-gold fissure veins at the Little Annie mine and at mines about 1.5 mi southeast strike N. 40°-50° W., dip steeply to the southwest, and are persistent over a length of about 2,000 ft. The quartz veins are branched, show abrupt pinch-outs, are generally less than 2 ft thick and locally are brecciated and have hematitic alteration. Pyrite cubes as much as 0.4 in. across are locally common, but specularite, galena, sphalerite, and chalcopyrite are present in only sparse amounts. Fire assays for gold from the dump material at these caved mines indicate gold values of 0.04-0.07 oz/ton; silver values are generally less than 0.2 oz/ton.

Other metal occurrences near the study area include: (1) Divines Gusto No. 1 mine in the SW1/4 sec. 7, T. 13 S., R. 78 W.—a gossanized quartz-pyrite-gold vein that strikes N. 70° E. in a migmatite lens within granite. The vein is about 35 ft long and 3 ft wide and contains about 0.25 ppm gold. (2) A series of trenches and an adit explore a N. 40° W.-striking quartz vein in a diorite plug along Buffalo Creek. Samples from this vein contained as much as 0.07 oz gold per ton, 0.2 oz silver per ton, and 0.2 percent copper. (3) Josephine mine group—A slightly uraniferous (1, 2, and 6 ppm equivalent U_3O_8) quartz-pyrite vein strikes N. 60° W. for 150 ft near the Otero pumping station. The vein is most radioactive at the intersection with hornblende schist xenoliths in granite. Fire assays indicate less than 0.05 oz of gold per ton by fire assay and less than 0.2 oz of silver per ton in vein samples. Other uranium-bearing quartz-gold veins in this area have been reported by Nelson-Moore and others (1978, p. 364-365). Extensive prospecting along the peridotite porphyry dikes a few feet north of the Otero pumping station road was for an unidentified mineral occurrence, probably uranium or elements of the platinoid group. Some of the dikes are slightly radioactive, especially along the contact with granite, but the dikes do not constitute a uranium resource. (4) Veins along Tie Gulch—chiefly hematite stained quartz veins just to the north of area C (fig. 2) that strike northwest, cut Precambrian granite, and are contiguous with large displacement faults of the Rio Grande-Arkansas Valley rift system. Fire assays of the vein indicate 0.005 oz of gold per ton and 0.2 oz of silver per ton.

Unlike the gold veins of the Granite district, the veins along Fourmile Creek and Tie Gulch lack anomalous concentrations of boron, strike north-northwest within the granitic rocks, contain fewer base metals, commonly contain magnetite and specularite, show high concentrations of bismuth, molybdenum, and tin and are not associated with rhyolite dikes. Most of the veins are outside the study area and generally have low gold values, 0.04-0.07 oz/ton.

Salt Creek area of the Fourmile-Buffalo Peaks districts (includes area D)

The vuggy, uraniferous jasperoid deposits at the Parkdale iron pit are along the study area boundary at the head of the Middle Fork of Salt Creek. This deposit was discovered by J. L. Amrine in the mid-1950's; shortly thereafter, about 52 tons of uraniferous jasperoid averaging 0.12 percent U_3O_8 and 0.20 percent V_2O_5 were shipped to the mill at Rifle, Colo. (Nelson-Moore and others, 1978, p. 365). The property remained idle until about 1976 when J. V. Dodge staked numerous claims that encompass much of the uraniferous jasperoid outcrops. A subsequent evaluation of the property indicated a reserve of about 4,000 tons of uraniferous jasperoid per vertical foot averaging 0.04 percent U_3O_8 within an area of 1,200 by 40 ft (C. M. Armstrong, written commun., 1977, 1978). Only about 3-4 ft of jasperoid is exposed in the Parkdale iron pit and in nearby trenches, but according to J. V. Dodge (oral commun., 1982) a drilling program conducted by Noranda Exploration, Inc., indicated that the uraniferous jasperoid is as much as 45 ft thick at the Parkdale iron pit.

At least 12 radioactive anomalies are known within or near the top of the Cambrian Sawatch Quartzite that forms a N. 40° W.-striking ridge in the district. The anomaly associated with the vuggy jasperoid at the Parkdale iron pit is as much as 40 times background. No uranium mineral was identified in this study; fission-track maps show that uranium is dispersed as an amorphous colloid through the ferruginous jasper. Opaline-quartz vug linings fluoresce yellowish green under ultraviolet light but do not contain significant amounts of uranium as compared with the jasperoid. Some vugs are also filled with manganosiderite but this carbonate is not radioactive, and like the opal, represents a later vug filling. Analyses of the radioactive jasperoid for uranium indicate the following values of equivalent U_3O_8 in parts per million: 36, 135, 241, and 243. A gamma-ray analysis of the most radioactive sample indicates equivalent uranium values of 287 and 288 ppm ±10 ppm and ^{232}Th values of less than 10 ppm (C. A. Bush, written commun., 1983). Fission-track map studies of the jasperoid indicate only 80 ppm uranium in some samples, and the uranium particles are extremely small, that is, micron size (R. A. Zielinski, oral commun., 1983). Semiquantitative spectrographic analyses of the uraniferous jasperoid indicate the presence of at least 20 percent iron, although C. M. Armstrong (written commun., 1977, 1978) has reported as much as 40 percent iron in some samples. The 12 fire assay analyses for gold and silver indicate less than 0.005 oz of gold per ton, and most silver values range from 0.2 to 0.3 oz of silver per ton. Other element concentrations in the radioactive jasperoid are: 5,000 ppm manganese, 150 ppm vanadium, 2,000-3,000 ppm zinc, 30-50 ppm lead, 5-55 ppm copper, 30-50 ppm nickel, and 30-50 ppm cobalt. A separate radiometric analysis indicates only 10-13 ppm thorium.

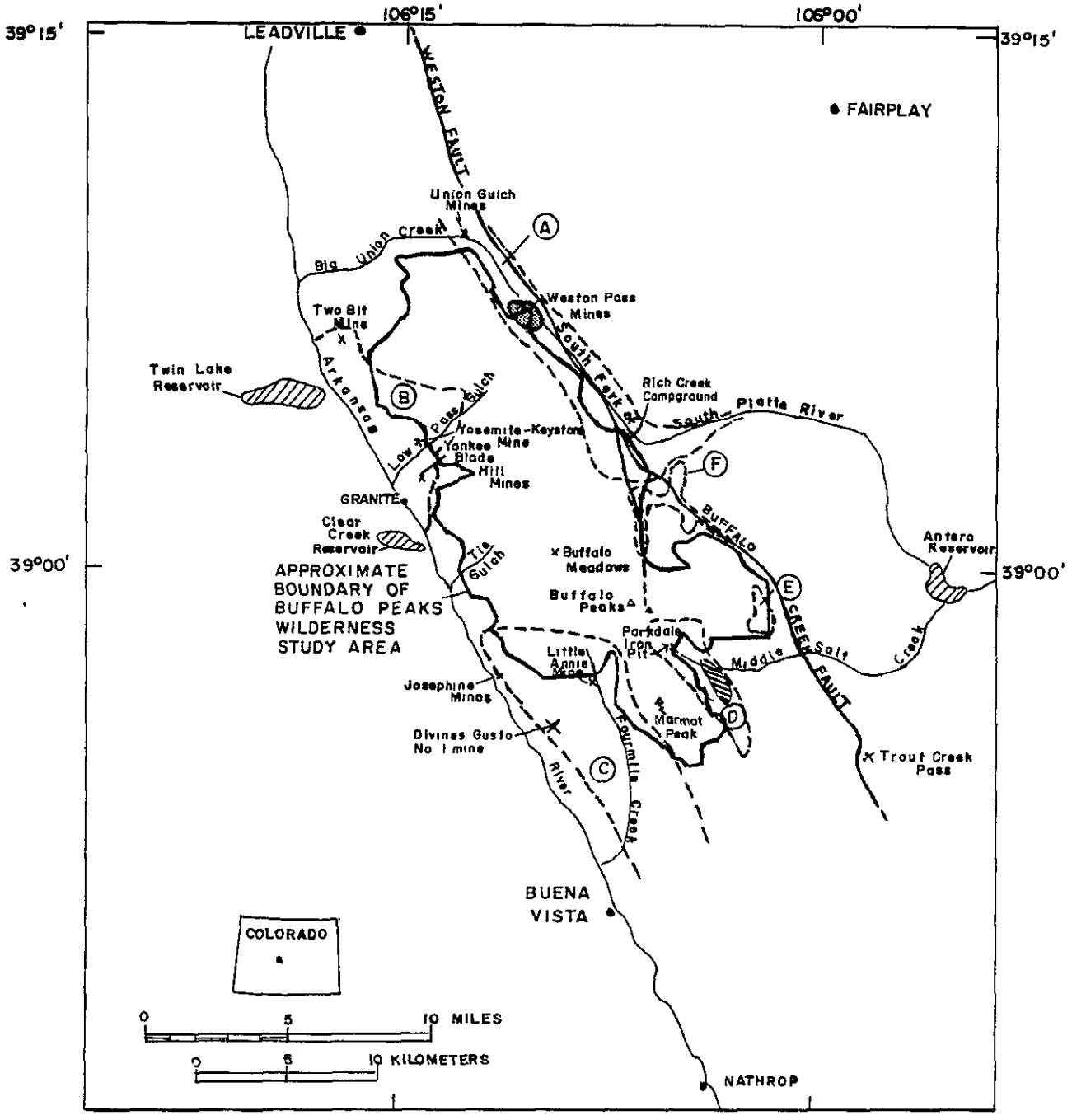

Figure 2.--Map showing areas having mineral resource potential in the Buffalo Peaks Wilderness Study Area, Colo.

EXPLANATION FOR FIGURE 2

AREA A--Moderate resource potential for silver in base-metal deposits; includes small area of high resource potential at Weston Pass indicated by stipple pattern

AREA B--Low to moderate resource potential for gold and silver in vein deposits

AREA C--Low to moderate resource potential for gold and silver in vein deposits and low resource potential for uranium in veins

AREA D--Low to moderate resource potential for uranium including a small low-grade uranium identified resource area around the Parkdale iron pit. Low to moderate resource potential for barite and lead in vein deposits. A small area along the northeast side of the Middle Fork of Salt Creek has low to moderate resource potential for silver in vein deposits; indicated by diagonal line pattern

AREAS E AND F--Low resource potential for barite and lead in vein deposits as defined by geochemical studies

Not all the jasperoids are radioactive and just south of the Parkdale iron pit a north-striking fracture zone of silicified, nonradioactive breccia forms a linear jaspery ridge that merges with the bedding replacement type of jasperoid at the pit. Trenches near the Parkdale pit are in a poorly exposed white, altered, biotite tuff of probable Oligocene age that possibly filled a paleovalley (Scott, 1975). The tuff is nonradioactive and has a very limited outcrop in the vicinity of the jasperoids.

Several hypotheses have been proposed for the origin of the uraniferous jasperoids: (1) the downward migration of acidic, meteoric waters have leached uranium from tuff during post-Oligocene time and have redeposited the uranium at the contact with the silica-rich Sawatch Quartzite, and (2) acidic hydrothermal fluids have leached uranium from the underlying fractured biotite granite (equivalent U_3O_8 = 80 ppm) and redeposited silica and uranium as a ferruginous gel at relatively low temperatures. The change of pH to alkaline conditions at the contact with the overlying Manitou Dolomite may have promoted precipitation of the uranium. Of the two hypotheses the hydrothermal source seems most probable since the fault-controlled jasperoids contain anomalous amounts of base metals, especially zinc, and the underlying Precambrian granite is anomalously radioactive.

In summary, the vuggy uraniferous jasperoids of the Parkdale iron pit straddle the study area boundary. At least 11 other smaller radioactive uranium-bearing jasperoids occur in the Sawatch Quartzite of area D (fig. 2) but the deposits lack continuity. The jasperoids contain less than 0.005 oz of gold per ton and the silver values range from less than 0.2 to 0.3 oz/ton. The deposits are not considered potential resources for iron ore because of their small size, although some jasperoids have as much as 40 percent iron, which would be a suitable grade for a taconite deposit if the deposits were closer to a processing facility.

The numerous small prospects along the east side of the Middle Fork of Salt Creek (area D, locality 4) have been extensively sampled by Wood (1983). These fault controlled deposits have negligible gold (0.005 oz/ton) but do contain minor amounts of silver (0.2-0.5 oz/ton).

A geochemical survey near the head of the North Fork of Salt Creek has indicated relatively high barium (5,000-10,000 ppm) and lead (30 to 1,500 ppm) anomalies in panned concentrates. These anomalies appear to be close to the northwest-striking fault that extends through locality 4.

Areas E and F

A geochemical survey (Nowlan and Gerstel, in press) has delineated two areas (E and F) of anomalous barium and lead values in stream-panned concentrates. The source areas of barite and galena were not discovered during this study.

Area E (fig. 2), in the vicinity of Spring Creek, yielded barium values of 2,000 and 10,000 ppm in analyzed stream-panned concentrates (Nowlan and Gerstel, in press). Other metals detected are 30 ppm lead, 10 ppm copper, and generally less than 500 ppm zinc.

Area F is elongate along the projection of the Buffalo Creek fault and also curves around the south edge of the rhyolite stock of Rough and Tumbling Creek (fig. 2). High barium values (3,000 to 10,000 ppm) are obtained from stream-panned concentrates along Willow Creek, about 2,000-3,000 ft east of the stock (Nowlan and Gerstel, in press). Some of these concentrates are also high in lead (70-1,500 ppm), and pyrite is observed in some samples. This area may be coextensive with area A and may represent an epithermal type mineralization that is synchronous with the ore deposition in the Weston Pass district to the northwest.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

A moderate resource potential was assigned to areas that met the following criteria (a low potential was assigned those areas that met only some of the criteria):

1. A favorable geologic environment such as the presence of numerous faults in a favorable host rock and the presence of Laramide and (or) Tertiary plutons.
2. Evidence of mineralization in adjacent areas along similar structural trends and favorable host rocks.
3. Anomalous metal values in rock and vein samples and in stream-sediment concentrates as determined from a geochemical study.
4. Aeromagnetic anomalies, such as extreme high and low gamma values in areas of broad magnetic gradients, may indicate the presence of hidden ore bodies.
5. Alteration halos related to hydrothermal fluids, for example, the chloritization of migmatite in the Granite district, the formation of vuggy jasperoids in the Salt Creek area. The dolomitization of Leadville Limestone to form "zebra-striped" rock in the Weston Pass-Union Gulch districts was probably important for favoring increased porosity and providing sites for later ore deposition.
6. The mineralized rock in and near the study area is of sufficient volume, grade, and accessibility so as to indicate a potential for the occurrence of resources.

These criteria are briefly discussed for the six mineralized areas, A through F.

There are no active mines within the study area, but about 2,000 acres of the Buffalo Peaks Wilderness Study Area are covered by mining claims (Wood, 1983). The various mineral resources within the described areas A-F are chiefly along the periphery of the study area and are discussed in order of decreasing resource potential. There is little or no indication for oil or gas or geothermal energy resources in the study area.

The six mineralized areas are:

Area A: This area is rated as having a moderate potential for silver resources in base-metal-bearing fissure veins and bedded replacement deposits. A very small part of this area at Weston Pass has a high resource potential because silver-bearing veins at the Gates mine extend into the study area. This assessment is based on the large number of faults

that displace favorable carbonate strata in the vicinity of known fault-controlled silver-bearing base-metal deposits. The extension of the Weston Pass mineral deposits to the northwest and southeast seems likely, and the intersection of the Weston fault zone with older northeast-striking faults would provide favorable structures for such deposits. Moreover, the presence of numerous silicified shatter zones and the favorable porosity provided by the dolomitized "zebra-striped" Leadville Limestone indicate possible sites for ore deposition.

Area B: This area has a low to moderate resource potential for gold and silver in vein deposits, but an extension of the precious-metal veins into the study area appears speculative.

Area C: The area has a low to moderate potential for gold and silver resources in veins. Most veins are outside of the study area, and the veins that are within the boundary are of low grade, that is, 0.04 oz of gold per ton and less than 0.02 oz of silver per ton.

Areas E and F: A geochemical survey has delineated several areas of anomalous barium and lead values in panned-stream concentrates. The sources of the probable barite-galena deposits were not discovered during this study, and therefore these areas have a low to moderate potential for the occurrence of barite and lead resources.

Area D: The uraniferous jasperoids of the Middle Fork of Salt Creek can be classified as an identified resource of low-grade uranium in the Parkdale iron pit area and the area has a low to moderate potential for additional uranium resources. The uraniferous jasperoids of the Bronco-Lady Elk claims have been thoroughly studied (J. V. Dodge, written commun., 1982) and a geologically inferred resource of about 4,000 tons per vertical foot of uraniferous jasperoid averaging 0.04 percent U_3O_8 and 0.20 percent V_2O_5 is suggested for an area of about 1,200 by 40 ft. The low-grade and the absence of precious metals make the uraniferous jasperoids at the Parkdale iron pit a low-grade uranium resource. The area of low-grade silver-bearing veins along the east side of the Middle Fork of Salt Creek (locality 4, tables 1 and 2) has a low to moderate resource potential for silver. The anomalous barium and lead values from panned concentrates at the head of the North Fork of Salt Creek suggest the presence of concealed barite-galena veins. On the basis of geochemical data, the resource potential for barite and lead in veins and bedded replacement deposits is low to moderate. Some of the jasperoid has as much as 40 percent iron, which would be a suitable grade for a taconite deposit if it was closer to a processing facility or if larger volumes of jasperoid were present.

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